CONTENTS

Testing and repair: W-001/507

Product: IE starting motor

Part no. 0 001 370 ...
0 001 371 ...

Continue: I01/2

CONTENTS

Continue: I02/1

SPECIAL FEATURES

These instructions describe repairs to type IE sliding-gear starting motors

0 001 370 ... 12 V/5.0 kW
0 001 371 ... 24 V/6.7 kW

Always use Loctite 5 965 930 512 on assembly to secure bearing pin of engaging lever in drive-end bearing.

Continue: I02/2

SPECIAL FEATURES

Renew needle bushings in drive-end and intermediate bearing.

All gaskets and seals are likewise to be renewed.

There is no test method for the solenoid switch which provides reliable information on trouble-free operation over a lengthy period. It is therefore advisable to renew the solenoid switch as well when repairing the starting motor.

Continue: I03/1

SPECIAL FEATURES

Prior to assembly, apply a small quantity of special grease 5 932 240 150 to the O-rings.

Continue: I01/1

STRUCTURE, USAGE

User prompting is provided on every page e.g.:
- Continue: I 17/1
- Continue: II 18/1 Fig.: II 17/2

Brief instructions may include several rows of coordinates.
I../. = first coordinate row
II../. = second coordinate row
III../. = third coordinate row
etc.

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: I01/1

GENERAL

Unless otherwise stated, the voltage values given in these instructions are AC values. The symbol "=" is used to indicate DC voltage.

Continue: I05/2

GENERAL

Expert repairs can only be performed with the prescribed tools and properly functioning measuring instruments. We therefore recommend that exclusive use be made of the tools indicated.

The use of incorrect and unsuitable tools and testers may result in injury and could cause damage to the product and components.

Continue: I06/1

GENERAL

Make exclusive use of service parts as per the replacement parts list for the type of starting motor concerned.

To guarantee proper functioning, use must be made of the lubricants prescribed in these instructions before and during assembly.

Take care to ensure cleanliness when performing repair work.

Continue: I01/1

SAFETY MEASURES

Component cleaning:
Armature, excitation winding, relay and overruning-clutch drive are only to be cleaned with compressed air (max. 4 bar) and a clean rag.
Never use liquid cleaning agent.

Other parts such as intermediate and drive-end bearing can be washed out in commercially available cleaning agent which is not readily flammable. Take care not to inhale vapors.

Continue: I07/2

SAFETY PRECAUTIONS

Danger of fire: Avoid naked flames, light and sparks.

ATTENTION:
Thoroughly dry cleaned components, as gases may subsequently form in the sealed starting motor and cause an explosion.

Always use tools indicated. The use of incorrect and unsuitable tools and testers could lead to injury.

Continue: I08/1

SAFETY PRECAUTIONS

Pay attention to the following safety regulations:

* Order governing work with flammable liquids (VbF) as issued by the German Ministry of Labor (BmA).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for handling chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  as issued by the Main Association for Professional Liability Insurance Associations (Central Association for Accident Prevention and Industrial Medicine), Langwartweg 103, 53129 Bonn.

Continue: I08/2

SAFETY PRECAUTIONS

Outside Germany, pay attention to the appropriate local regulations.

Skin protection:
To prevent skin irritation when working with oil and grease, apply hand cream before starting work and wash hands in soap and water afterwards.

Continue: I01/1

TESTERS, FIXTURES, TOOLS

The following list indicates all the tools required for repairing type IE starting motors.

Some of the tools needed must be user-manufactured in line with drawings.

If tools used to be ordered on the basis of type designation, this is indicated in parentheses.

Continue: I09/2

TESTERS, FIXTURES, TOOLS

Interturn-short-circuit tester with test prods:	0 986 619 110
Test prods:	0 986 619 101
(old version:	0 986 619 114)
Alternator tester WPG 012.00:	0 684 201 200
(optionally Motortester)	
Magnetic instrument stand:	4 851 601 124
Dial indicator:	1 687 233 011
Mandrel press:	comm. avail.

Continue: I10/1

TESTERS, FIXTURES, TOOLS

Clamping support:	0 986 619 362 (KDAW 9999)
Claw-type puller:	comm. avail.
Depth gauge:	comm. avail.
Torque wrench (0...70 Nm):	comm. avail.
Torquemeter (0.15...0.80 Nm):	0 986 617 206 (KDAL 5485)
Spring balance (0...160 N):	comm. avail.

Continue: I10/2

TESTERS, FIXTURES, TOOLS

Spring balance (2...12 N):	0 986 619 181 (KDAW 9991)
Pole-shoe screwdriver:	0 986 619 393 (KDAW 9999/7)
Torx T50 bit socket with hexagon 5/16":	comm. avail.
Torx T40 bit socket with hexagon 1/4":	comm. avail.
Torx T30 bit socket with hexagon 1/4":	comm. avail.

Continue: I11/1

TESTERS, FIXTURES, TOOLS

Pressing-out mandrel for needle bushing in intermediate bearing:	0 986 617 129 (KDAL 5039)
Pressing-in mandrel for needle bushing in intermediate bearing:	0 986 617 130 (KDAL 5040)
Pressing-in mandrel for radial-lip-type oil seal in intermediate bearing:	0 986 617 144 (KDAL 5053)
Assembly tool for brush holder plate:	0 986 617 145 (KDAL 5054)

Continue: I11/2

TESTERS, FIXTURES, TOOLS

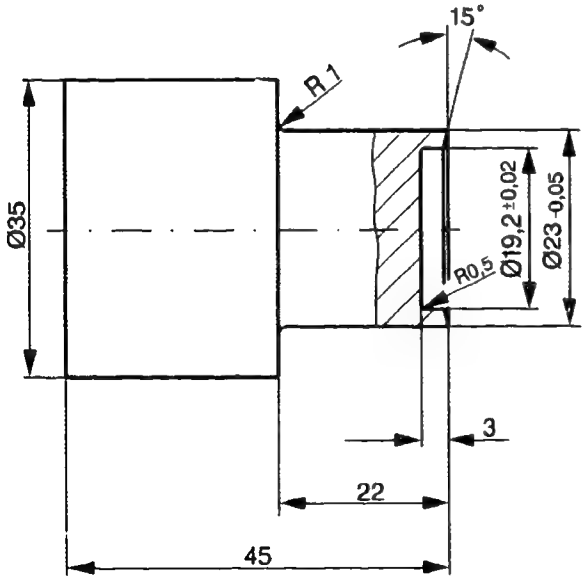
Tailstock chuck with Morse taper 2 for clamping diameter 5...45 mm for holding armature when turning down:	0 986 619 156 (KDAW 9987)
Driving-in mandrel diameter:	75,85 - 0,05 mm (user-manufacture)

Continue: I12/1

Pressing-out/pressing-in
mandrel for needle
bushing in
drive-end bearing: user-manufacture

Continue: I01/1 Fig.: I12/2

KMS00159



TEST SPECIFICATIONS AND SETTINGS

Min. commutator dia.:	42,5 mm
Radial runout	
- Commutator:	0,03 mm
- Laminated core:	0,08 mm
Carbon brush as-new size:	17,5 mm
Carbon brush min. size:	9,5 mm
Brush pressure with new carbon brushes:	47...53 N
Armature axial clearance:	0,1...0,3 mm

Continue: I13/2

TEST SPECIFICATIONS AND SETTINGS

Armature braking torque:	0,8... 1,2 Nm
Pinion rest pos. a:	47 ...49 mm
Tot. pinion travel b:	68,2... 70,8 mm
Pinion displacement:	10 ... 11,4 mm
Installation dimension a of needle bushing in drive-end bearing:	146,8...147,2 mm

Continue: I14/1

TEST SPECIFICATIONS AND SETTINGS

Shunt field resistance		
12 V starting motor:	0,38 ...0,42	Ohm
24 V starting motor:	1,60 ...1,76	Ohm

Resistances		
Solenoid switch - 12 V		
Pull-in winding:	0,175...0,185	Ohm
Holding winding:	0,421...0,443	Ohm
Solenoid switch - 24 V		
Pull-in winding:	0,524...0,552	Ohm
Holding winding:	1,6 ...1,7	Ohm

Continue: I01/1

TIGHTENING TORQUES

Bearing end plate attachment to commutator end shield:	4...5	Nm
Attachment of commutator end shield and drive-end bearing:	9,8...12,2	Nm
Relay attachment:	7,6... 8,4	Nm
Bearing pin of engaging lever in drive-end bearing (hexagon nut):	9...11	Nm
Pole-shoe screws:	40...53	Nm
Stranded wires, carbon brushes:	3... 4	Nm
Terminal screw, excitation winding:	15...17	Nm

Continue: I15/2

TIGHTENING TORQUES

Attachment of busbar to terminal screw of excitation winding:	15...17	Nm
Attachment of busbar to solenoid switch:	16...20	Nm
Terminal stud, ground connection (insulated design only):	17...19	Nm
Connection, ground cable (insulated design only):	15...17	Nm

Continue: I01/1

LUBRICANTS/LUBRICATION SCHEDULE

General:
Always keep commutator and carbon brushes free from grease and oil.

Greased parts are to be degreased before being relubricated.

Slightly lubricate bright parts (bolts, nuts, fits etc.).

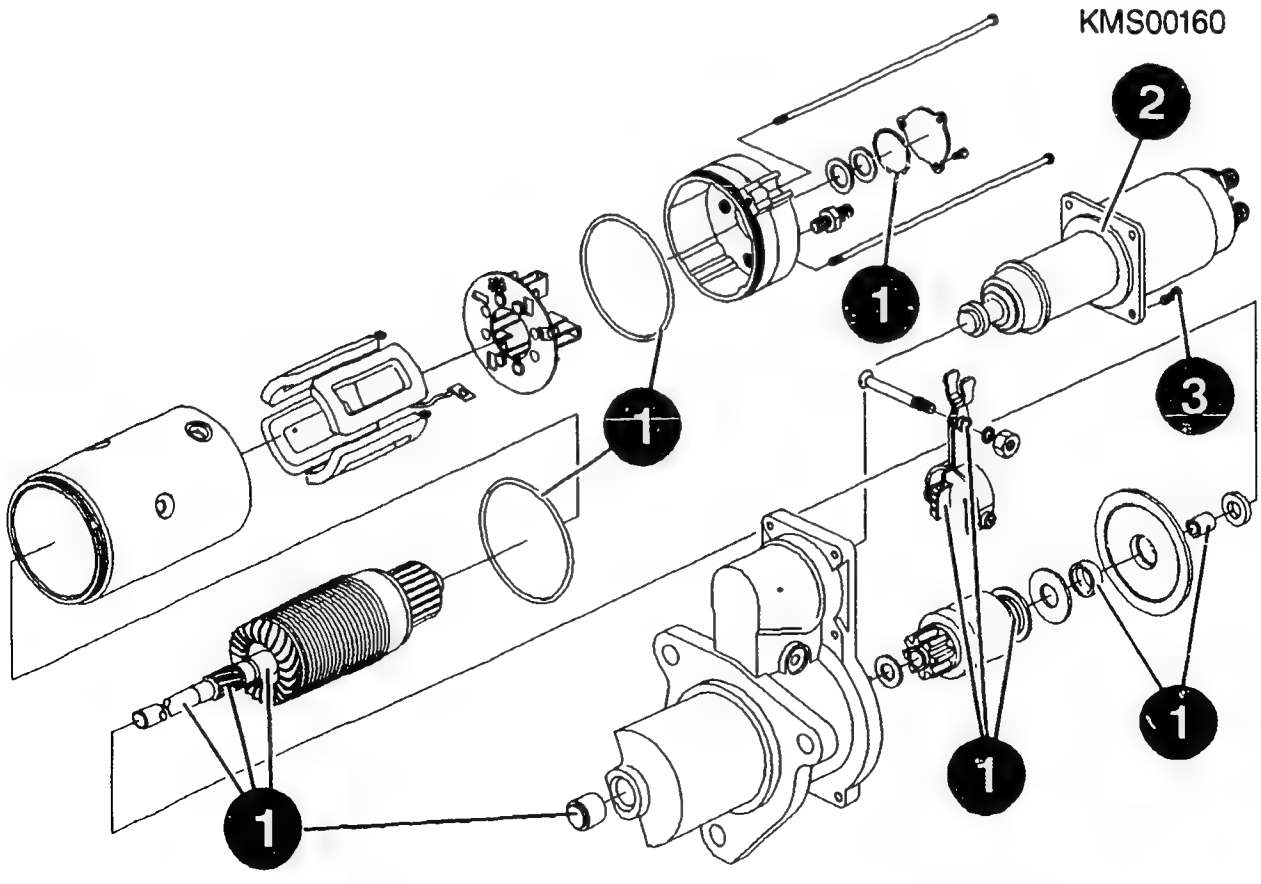
Oil 41 v 2: 5 701 351 000

Continue: I17/1

LUBRICANTS/LUBRICATION SCHEDULE

1	=	Grease VS 10832 Ft	5 932 240 000
2	=	Grease VS 16634 Ft	5 990 260 000
3	=	Loctite for securing screws VS 14618 Kk	5 965 930 512

Continue: I01/1 Fig.: I17/2



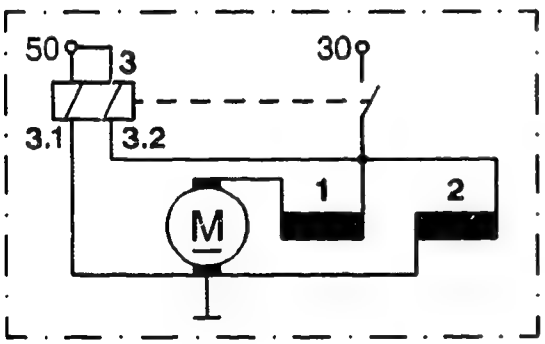
CIRCUIT DIAGRAM

Standard version

1	=	Series winding
2	=	Shunt winding
3	=	Solenoid switch
3.1	=	Holding winding
3.2	=	Pull-in winding

Continue: I19/1 Fig.: I18/2

KMS00161



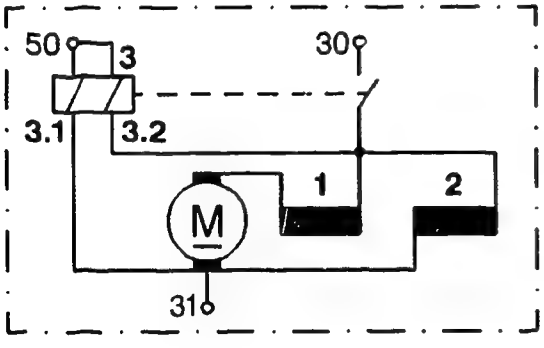
CIRCUIT DIAGRAM

Insulated design

1	=	Series winding
2	=	Shunt winding
3	=	Solenoid switch
3.1	=	Holding winding
3.2	=	Pull-in winding

Continue: I01/1 Fig.: I19/2

KMS00162



STARTING-MOTOR DISASSEMBLY TABLE

Continue: I01/1

STARTING MOTOR DISASSEMBLY

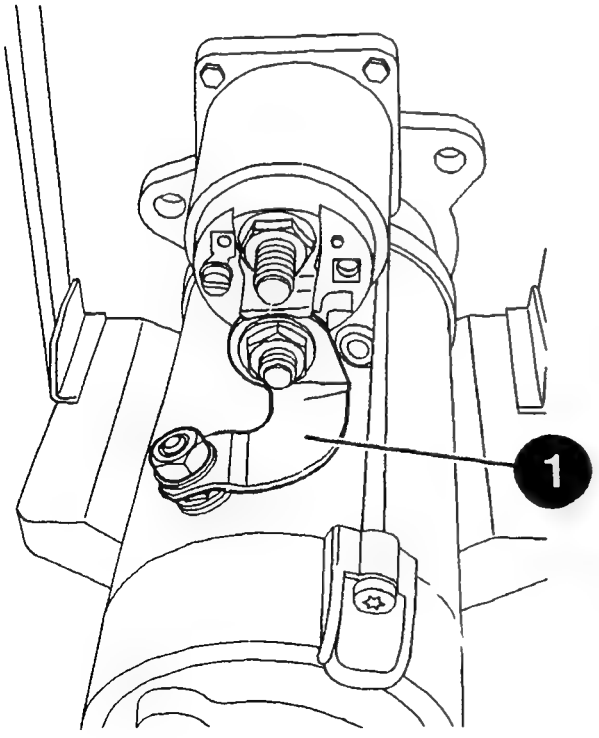
Solenoid switch disassembly

Clamp starting motor in clamping support.
Remove busbar (1).

Clamping support: 0 986 619 362

Continue: I22/1 Fig.: I21/2

KMS00163



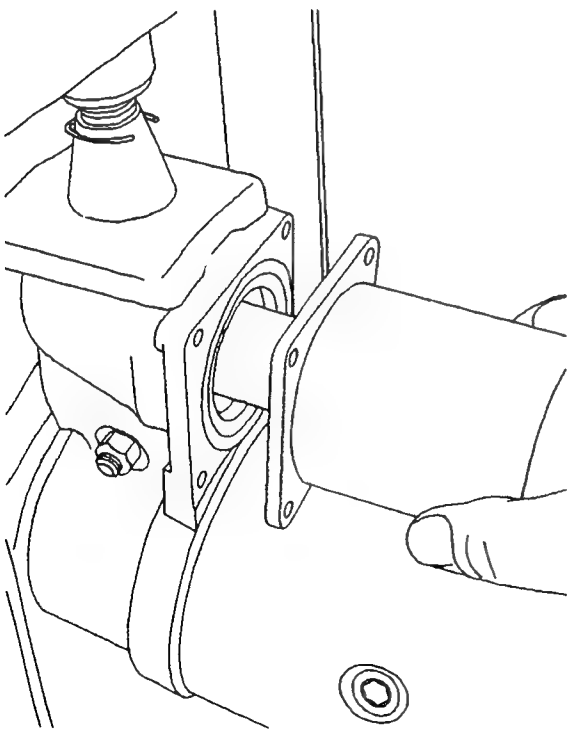
STARTING MOTOR DISASSEMBLY

Solenoid switch disassembly

Mark position of solenoid switch.
Unfasten switch securing bolts.
ATTENTION: DANGER OF INJURY!
The pretensioned return spring depresses solenoid switch off switch armature.
Pull switch off armature.

Continue: I23/1 Fig.: I22/2

KMS00164



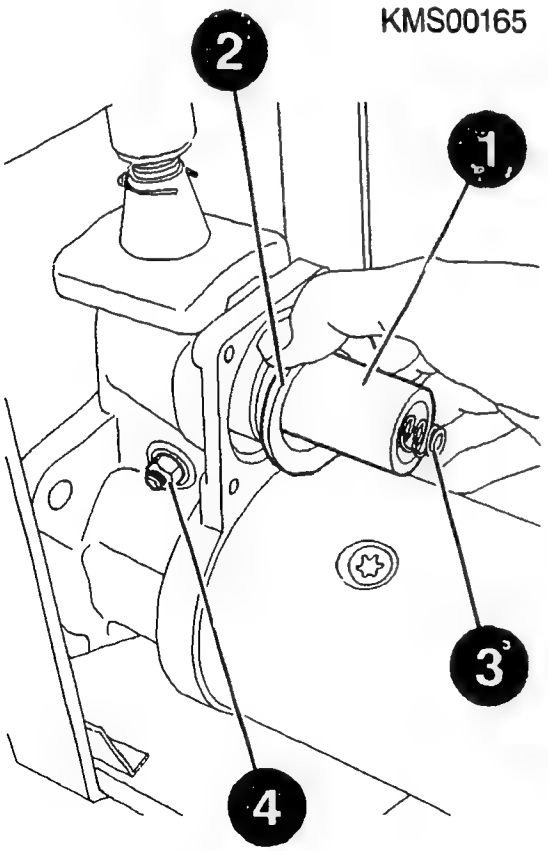
STARTING MOTOR DISASSEMBLY

Solenoid switch disassembly

Grasp switch armature (1) at rubber bellows (2) and detach at engaging lever.
Pay attention to return spring (3) in switch armature.
Unfasten bearing pin (4) of engaging lever in drive end bearing.

Torx T40 bit socket: comm. avail.

Continue: I24/1 Fig.: I23/2



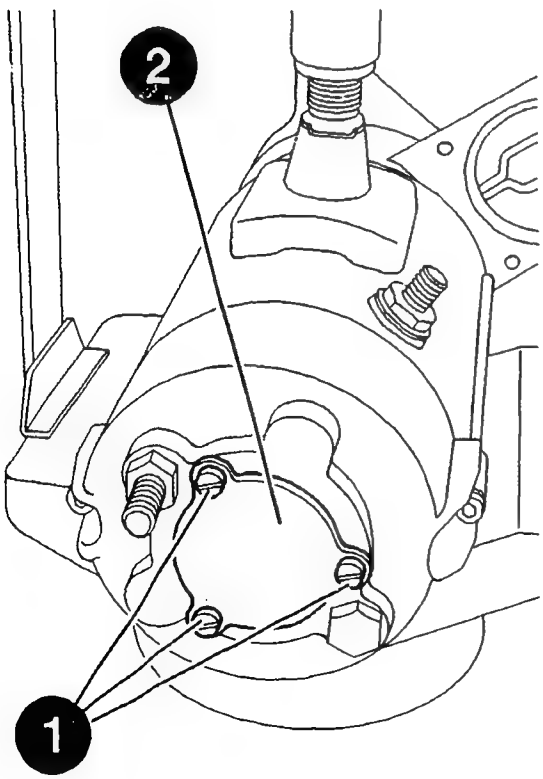
STARTING MOTOR DISASSEMBLY

Bearing end plate disassembly

Re-clamp starting motor.
Unfasten securing bolts (1) of bearing end plate (2).
Remove bearing end plate.

Continue: I25/1 Fig.: I24/2

KMS00166



STARTING MOTOR DISASSEMBLY

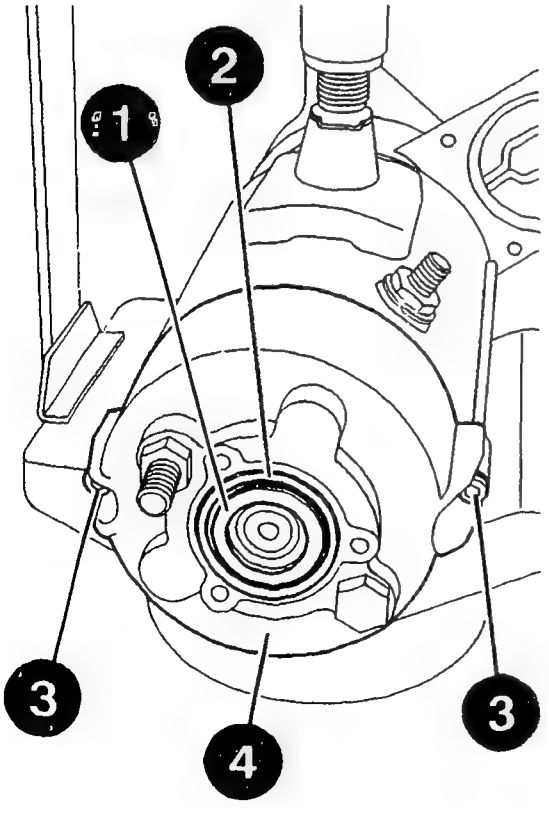
Commutator end shield disassembly

Remove shims (1) for setting armature axial clearance and O-ring (2).
Mark installation position of commutator end shield and drive end bearing.
Unfasten bolts (3) and remove commutator end shield (4).
ATTENTION: DANGER OF ACCIDENT!
The drive end bearing is not fixed at the stator frame.

Torx T30 bit socket: comm. avail.

Continue: I26/1 Fig.: I25/2

KMS00167



STARTING MOTOR DISASSEMBLY

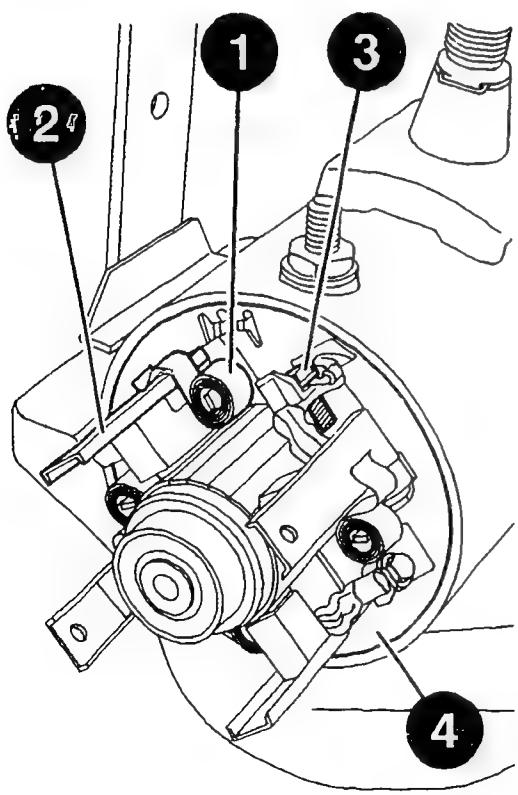
Brush holder plate disassembly

Use suitable tool to raise spiral springs (1) and insert assembly tool (2) between spring and brush holder.
Unfasten connections (3) of excitation winding and carbon brushes at brush holder plate (4).
Remove brush holder plate.

Assembly tool for brush holder plate: 0 986 617 145

Continue: I27/1 Fig.: I26/2

KMS00168



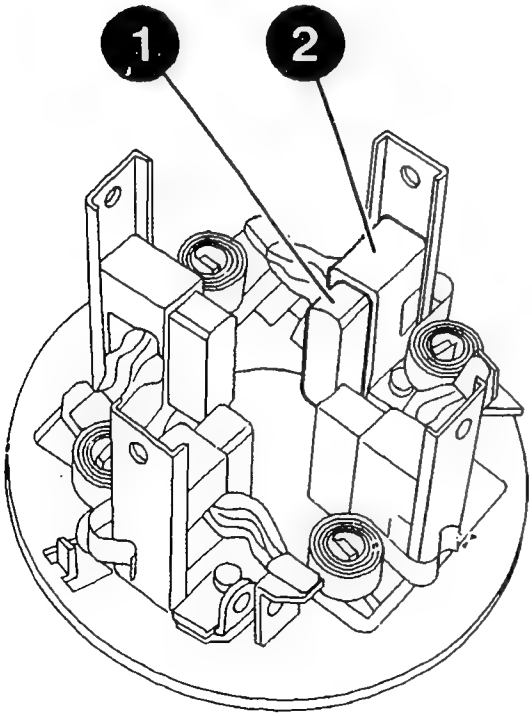
STARTING MOTOR DISASSEMBLY

Carbon brush disassembly

Mark installation position of carbon brushes (1).
Remove carbon brushes from brush holders (2).

Continue: I28/1 Fig.: I27/2

KMS00169



STARTING MOTOR DISASSEMBLY

Drive end bearing disassembly

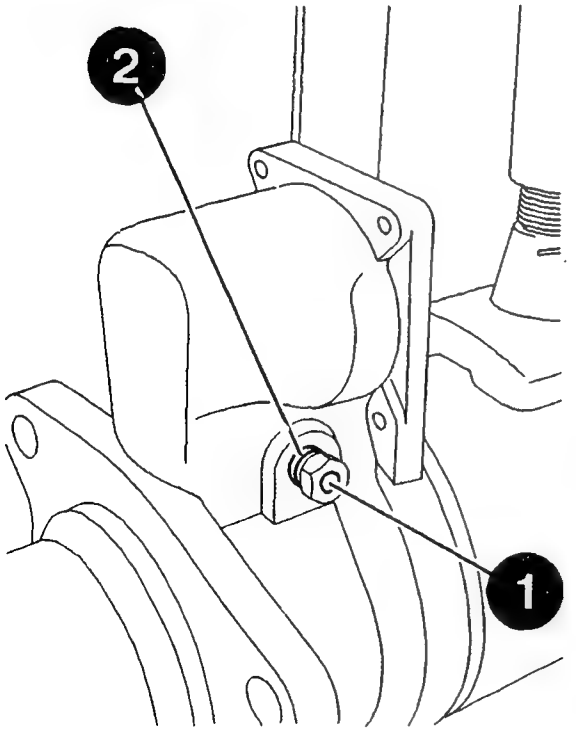
Screw out bearing pin (1) of engaging lever in drive end bearing.

Note:
A new copper seal (2) is to be used on assembly.

Torx T40 bit socket: comm. avail.

Continue: II01/1 Fig.: I28/2

KMS00170



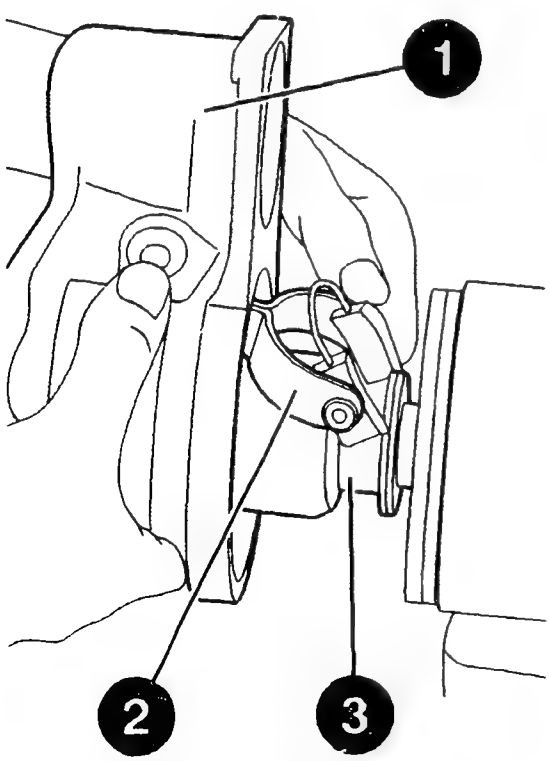
STARTING MOTOR DISASSEMBLY

Drive end bearing disassembly

Remove drive end bearing (1) from stator frame. In doing so, detach engaging lever (2) from driver (3) at overruning-clutch drive.

Continue: II02/1 Fig.: II01/2

KMS00171



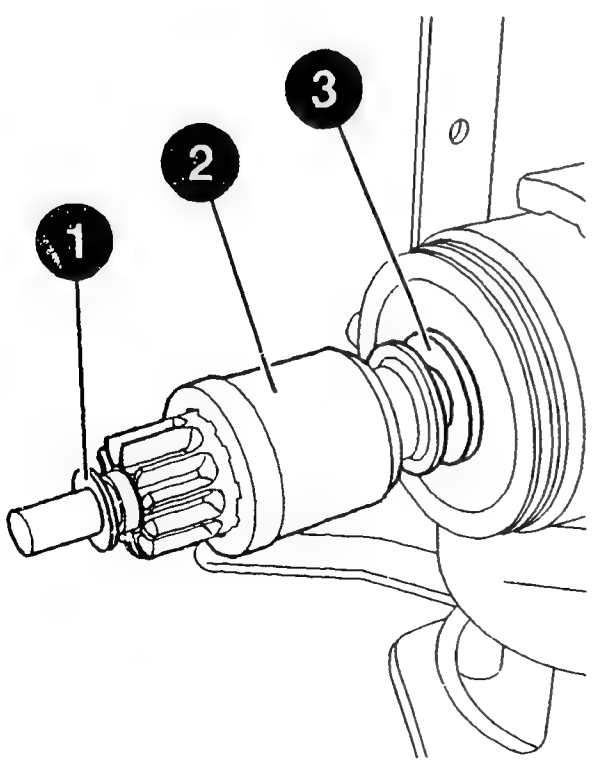
STARTING MOTOR DISASSEMBLY

Gear unit disassembly

Remove stop disk (1), overrunning-clutch drive with pinion (2) and brake disk (3) from armature shaft.

Continue: II03/1 Fig.: II02/2

KMS00172



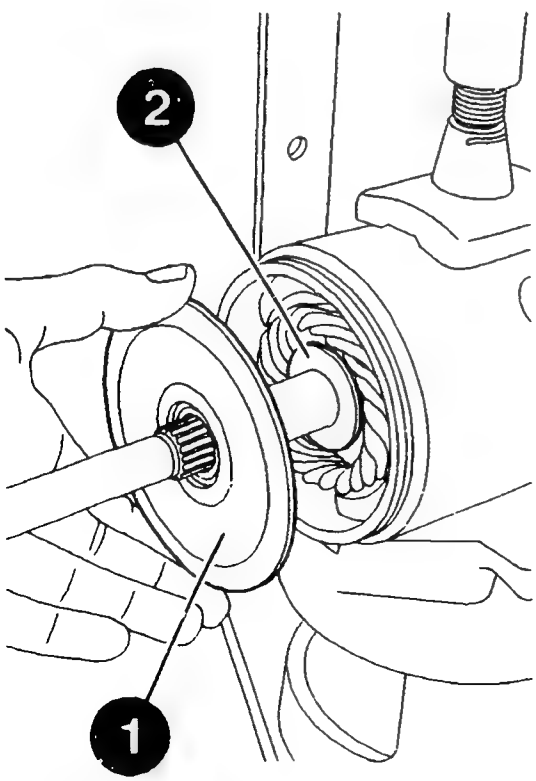
STARTING MOTOR DISASSEMBLY

Intermediate bearing disassembly

Remove intermediate bearing (1) and thrust washer (2) from armature shaft.

Continue: II04/1 Fig.: II03/2

KMS00173



STARTING MOTOR DISASSEMBLY

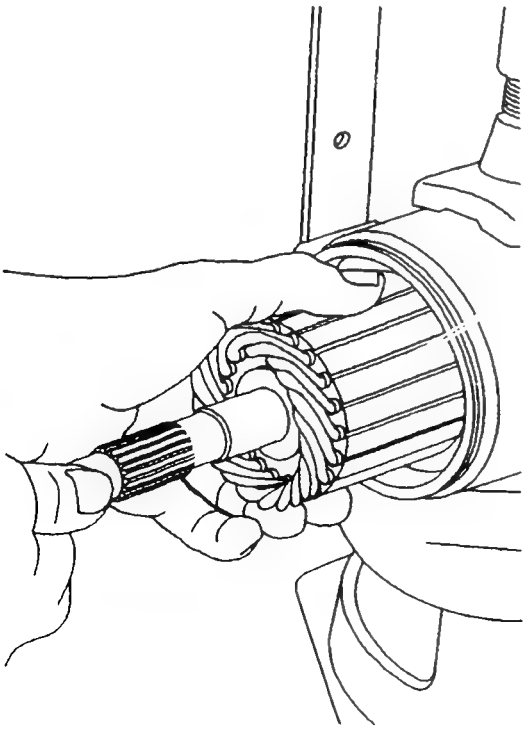
Armature disassembly

Pull armature on drive end out of stator frame.

ATTENTION:
Take care not to damage excitation winding.

Continue: I01/1 Fig.: II04/2

KMS00174



COMPONENT CLEANING

Component cleaning:
Armature, excitation winding, relay and overruning-clutch drive are only to be cleaned with compressed air (max. 4 bar) and a clean rag.
Never use liquid cleaning agent.

Other parts such as intermediate and drive-end bearing can be washed out in commercially available cleaning agent which is not readily flammable. Take care not to inhale vapors.

Continue: II05/2

CLEANING OF COMPONENTS

Danger of fire: Avoid naked flames, light and sparks.

ATTENTION:
Thoroughly dry cleaned components, as gases may subsequently form in the sealed starting motor and cause an explosion.

Continue: II06/1

CLEANING OF COMPONENTS

Pay attention to the following safety regulations:

* Order governing work with flammable liquids (VbF) as issued by the German Ministry of Labor (BmA).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for handling chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  as issued by the Main Association for Professional Liability Insurance Associations (Central Association for Accident Prevention and Industrial Medicine), Langwartweg 103, 53129 Bonn.

Continue: II06/2

CLEANING OF COMPONENTS

Outside Germany, pay attention to the appropriate local regulations.

Continue: I01/1

TESTING, REPAIR TABLE

Continue: II07/2

TESTING, REPAIR TABLE

Continue: I01/1

COMPONENT TESTING AND REPAIR

Checking pinion

Check pinion for running marks and chipping.
If appropriate, replace pinion complete with overrunning-clutch drive.
If end face of pinion is worn, engaging lever must also be replaced in addition to overruning-clutch drive.

Continue: II09/1

COMPONENT TESTING AND REPAIR

Checking drive end bearing

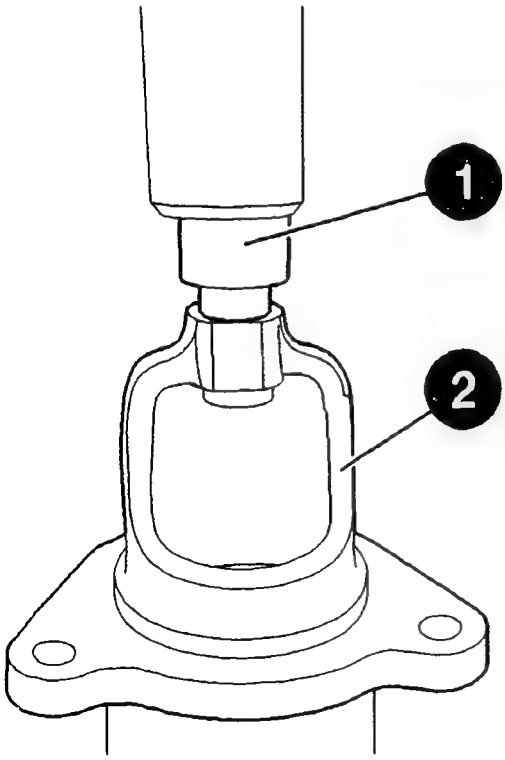
Always replace needle bushing of drive end bearing.

Removing: Use pressing-out mandrel (1) to press needle bushing out of drive end bearing (2).

Mandrel press:	comm. avail.
Pressing-out/pressing-in mandrel:	user-manufacture

Continue: II10/1 Fig.: II09/2

KMS00175



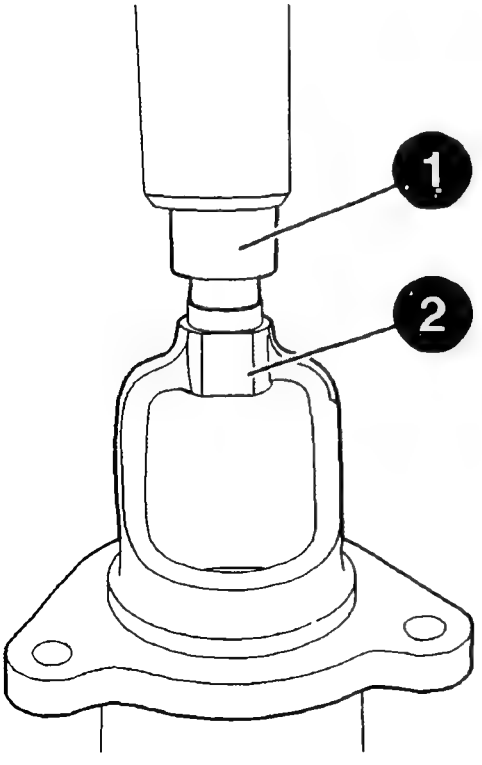
Checking drive end bearing

Installing: Grease new needle bushing before pressing it in and press from outside into drive end bearing (2) using pressing-out/pressing-in mandrel (1).
ATTENTION: Note installation dimension.

Mandrel press:	comm. avail.
Pressing-out/pressing -in mandrel:	user manufacture
Grease VS 10832 Ft:	5 932 240 000

Continue: II11/1 Fig.: II10/2

KMS00176



COMPONENT TESTING AND REPAIR

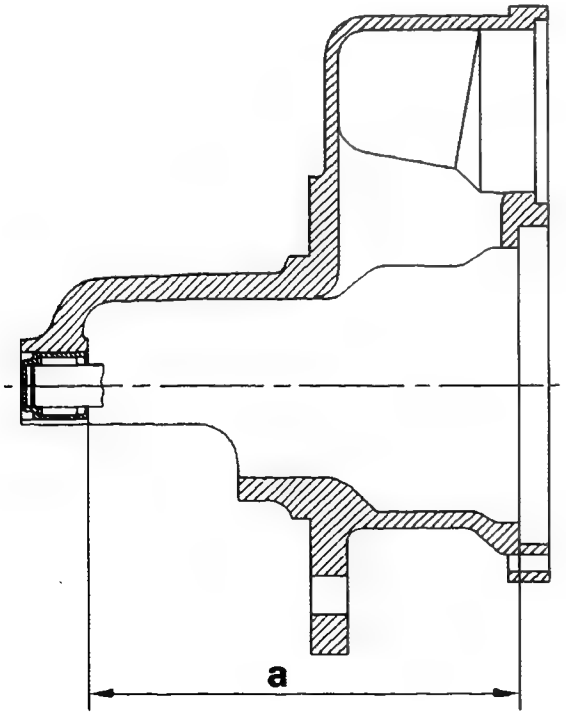
Checking drive end bearing

Installing: Needle bushing is to be pressed into drive end bearing so as to ensure compliance with installation dimension a between contact surface of drive end bearing and collar of needle bushing.

Depth gauge:	comm. avail.
Installation dimension a:	146,8...147,2 mm

Continue: II12/1 Fig.: II11/2

KMS00237



COMPONENT TESTING AND REPAIR

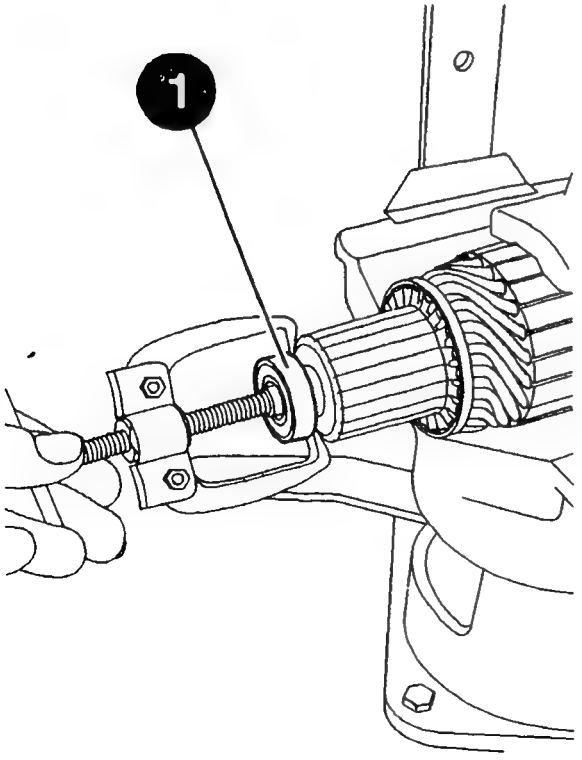
Checking commutator end shield

Check deep-groove ball bearing on commutator end of armature for damage and smooth running.
Replace if appropriate.
Removing: Clamp armature in clamping support.
Use claw-type puller to remove deep-groove ball bearing (1) from armature shaft.

Clamping support:	0 986 619 362
Claw-type puller:	comm. avail.

Continue: II13/1 Fig.: II12/2

KMS00177



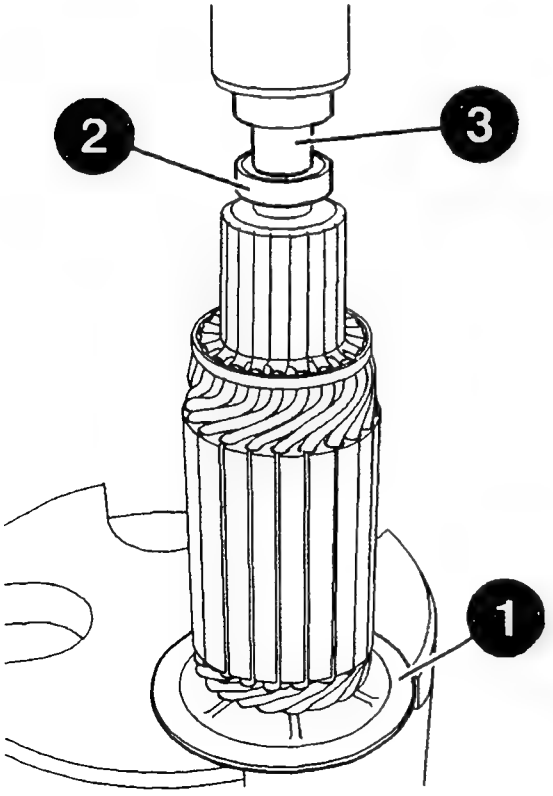
Checking commutator end shield

Installing: Slip intermediate bearing (1) onto armature shaft to support armature on mandrel press.
Press new deep-groove ball bearing (2) onto armature shaft. To do so, use pressing-in mandrel for needle bushing of intermediate bearing (3).

Mandrel press:	comm. avail.
Pressing-in mandrel for needle bushing in intermediate bearing:	0 986 617 130

Continue: II14/1 Fig.: II13/2

KMS00178



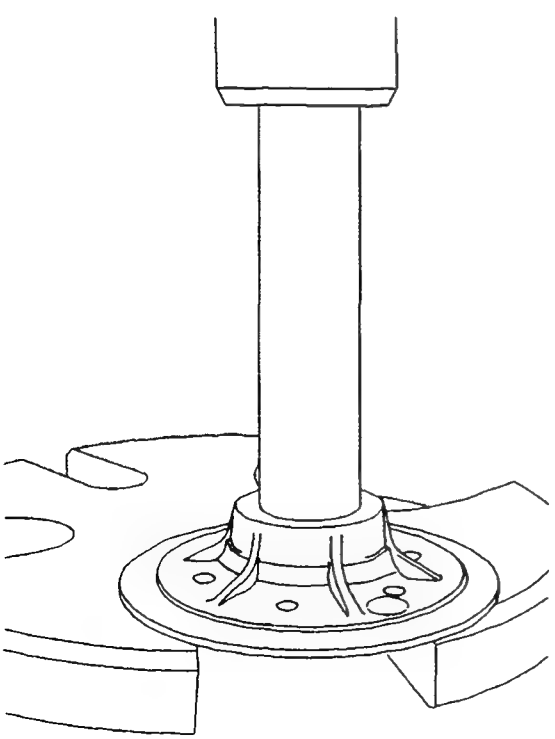
Checking intermediate bearing

Check thrust washer for damage and replace if necessary.
Always replace needle bushing of intermediate bearing and radial-lip-type oil seal.
Removing: Press needle bushing and radial-lip-type oil seal out of intermediate bearing.

Mandrel press:	comm. avail.
Pressing-out mandrel for needle bushing in intermediate bearing:	0 986 617 129

Continue: II15/1 Fig.: II14/2

KMS00179



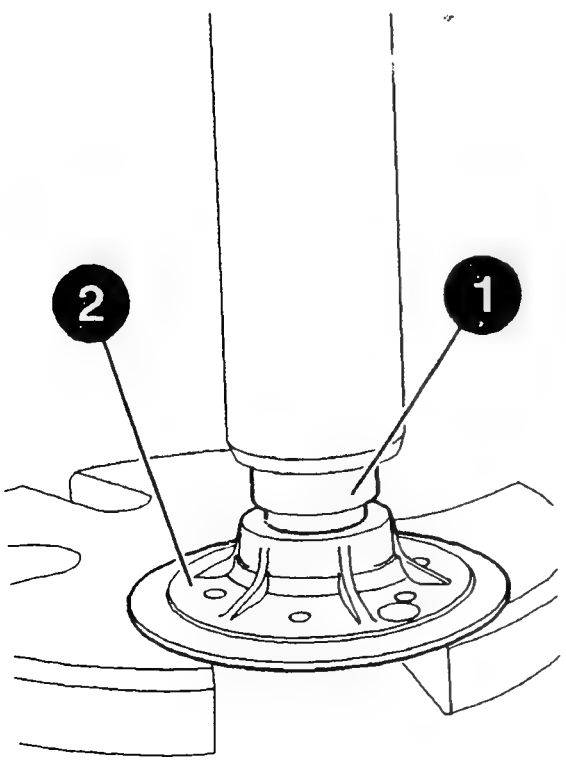
Checking intermediate bearing

Installing needle bushing:
Grease new needle bushing before pressing it in. Attach needle bushing to pressing-in mandrel (1) and press home in intermediate bearing (2) as far as pressing-in mandrel will go.

Mandrel press:	comm. avail.
Pressing-in mandrel for needle bushing in intermediate bearing:	0 986 617 130
Grease VS 10832 Ft:	5 932 240 000

Continue: II16/1 Fig.: II15/2

KMS00180



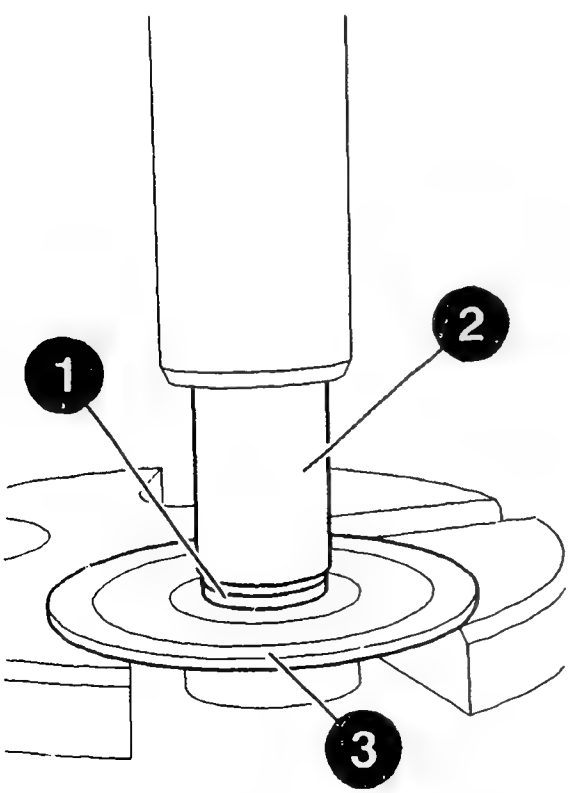
Checking intermediate bearing

Installing radial-lip-type oil seal:
Grease new seal (1) lightly before pressing it in and slip onto pressing-in mandrel (2) with open end facing upwards towards mandrel.

Pressing-in mandrel for radial-lip-type oil seal in intermediate bearing:	0 986 617 144
Grease VS 10832 Ft:	5 932 240 000

Continue: II17/1 Fig.: II16/2

KMS00181



COMPONENT TESTING AND REPAIR

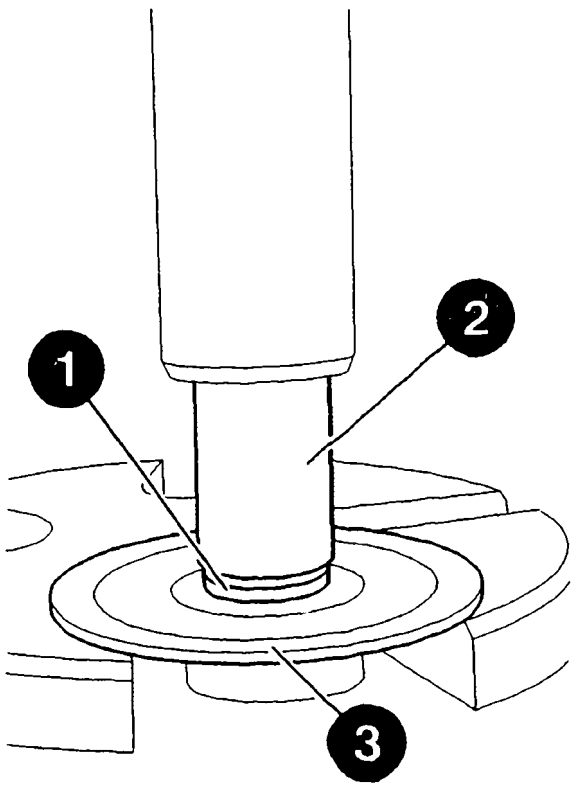
Checking intermediate bearing

Installing radial-lip-type oil seal:
Press home oil seal (1) in intermediate bearing (3) as far as pressing-in mandrel (2) will go.
Make sure pressing-in mandrel is properly centered in needle bushing.

Mandrel press:	comm. avail.
Pressing-in mandrel for radial-lip-type oil seal in intermediate bearing:	0 986 617 144
Grease VS 10832 Ft:	5 932 240 000

Continue: II18/1 Fig.: II17/2

KMS00181



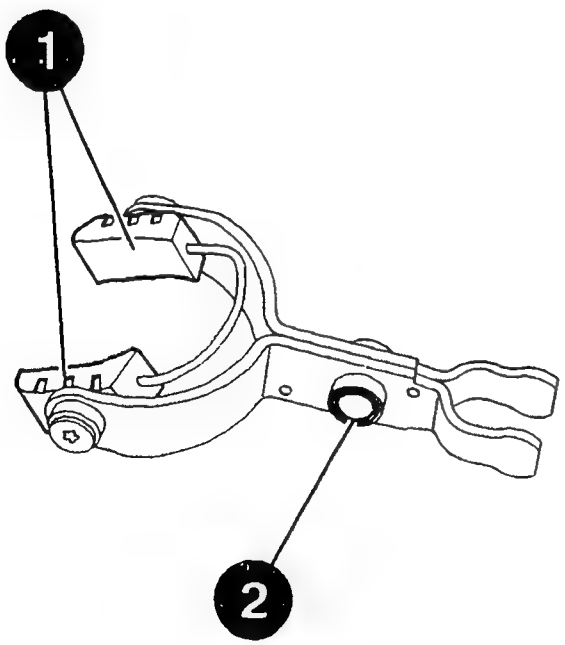
COMPONENT TESTING AND REPAIR

Checking engaging lever

Engaging lever must be replaced if sliders (1) or bushing (2) of engaging lever are/is worn.

Continue: II19/1 Fig.: II18/2

KMS00182



Checking gear unit

Check brake disk for damage and replace if necessary.

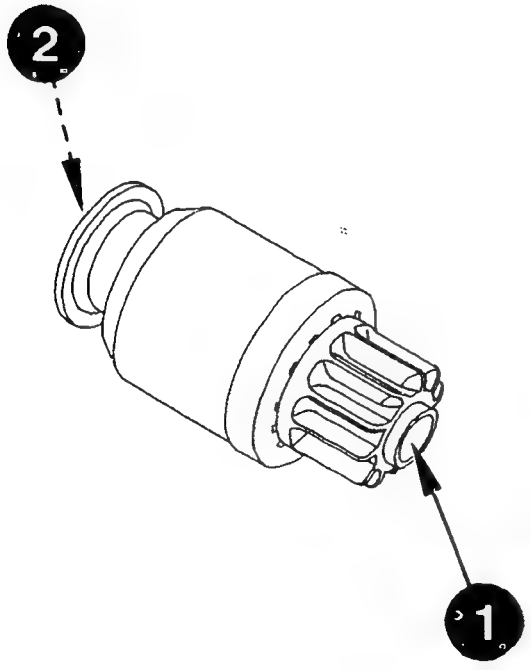
Continue: II20/1

Checking gear unit

Entire overrunning-clutch drive must be replaced if mount (1) or spline shaft profile (2) exhibits running marks or shows signs of damage.

Continue: II21/1 Fig.: II20/2

KMS00184



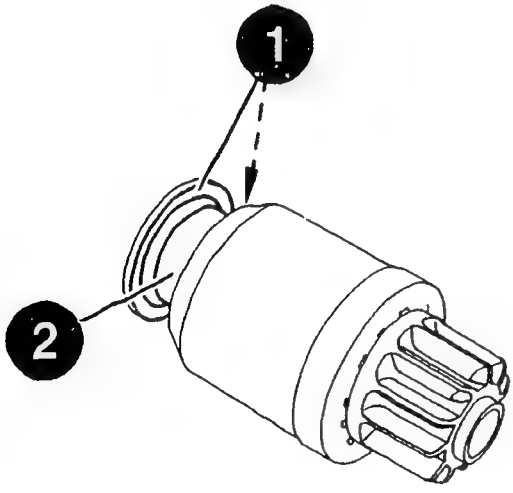
COMPONENT TESTING AND REPAIR

Checking gear unit

Check driver of engaging lever. Entire gear unit must be replaced if sliders of engaging lever have worn down edges (1) of driver (2).

Continue: II22/1 Fig.: II21/2

KMS00185



COMPONENT TESTING AND REPAIR

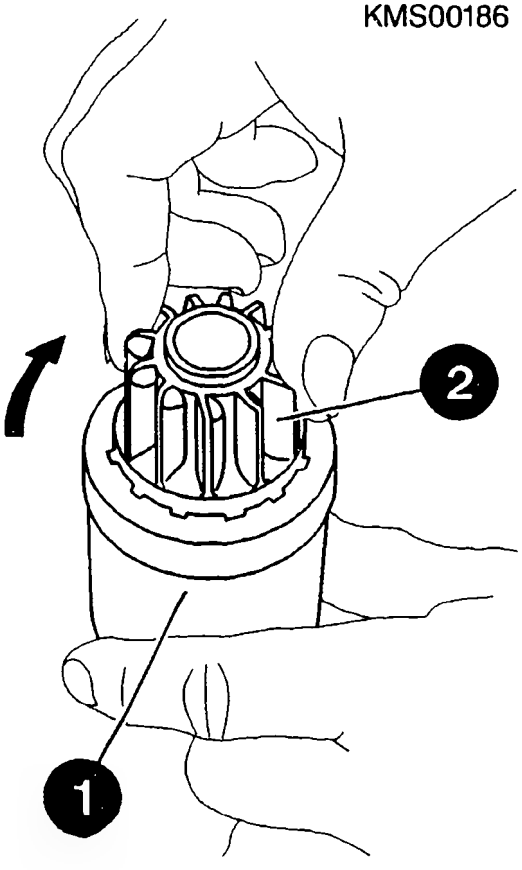
Checking gear unit

Check overrunning clutch.
Hold housing (1) of overrunning clutch and turn pinion (2) in direction of operation (arrow).
Functioning of overrunning clutch must be indicated by audible engaging of the clutch toothing.

Hold housing and turn pinion in opposite direction - positive locking must be found.

Continue: II23/1 Fig.: II22/2

KMS00186

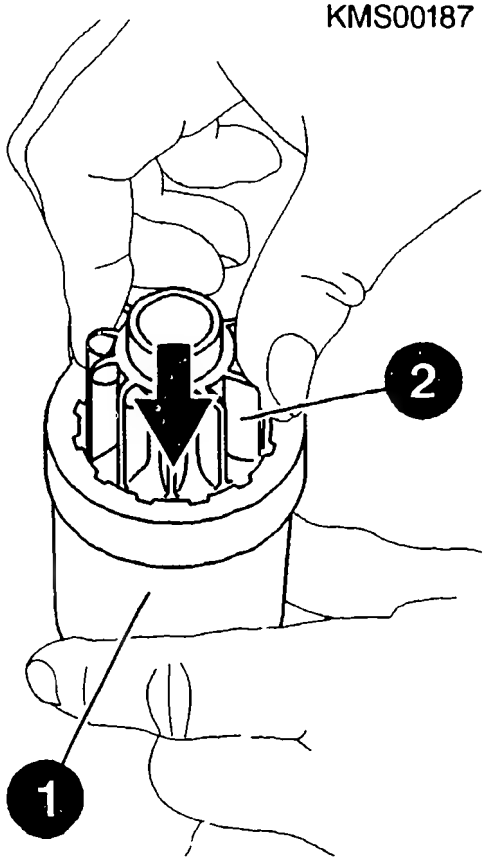


Checking gear unit

Check meshing spring.
Hold housing (1) of overrunning clutch and press pinion (2) into housing as far as it will go.
Pinion displacement: 10...11,4 mm
Pinion must return to its initial position on being released.

Continue: II24/1 Fig.: II23/2

KMS00187



COMPONENT TESTING AND REPAIR

Checking carbon brushes

Check tightness of connections.
Replace carbon brushes if contact surfaces are scored or chipped or if minimum size has been reached.

As-new brush size:	17,5 mm
Min. brush size:	9,5 mm

Continue: II25/1

COMPONENT TESTING AND REPAIR

Checking brush holder plate

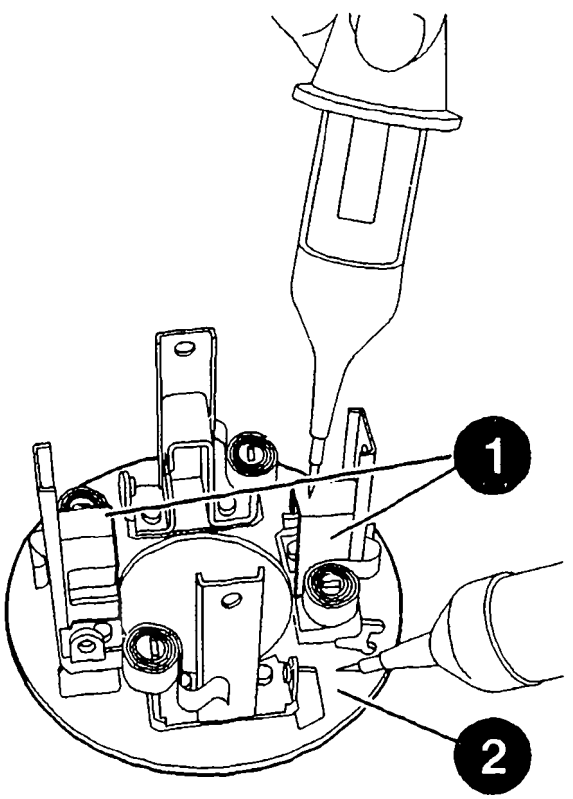
Replace damaged, rusty or scorched springs.
Check for short to ground in brush holders (1), which are insulated with respect to brush holder plate (2).

Interturn-short-circruit tester:	0 986 619 110
Test prods:	0 986 619 101

Ground-short test voltage	
12 V starting motor:	40 V
24 V starting motor:	80 V

Continue: II26/1 Fig.: II25/2

KMS00188

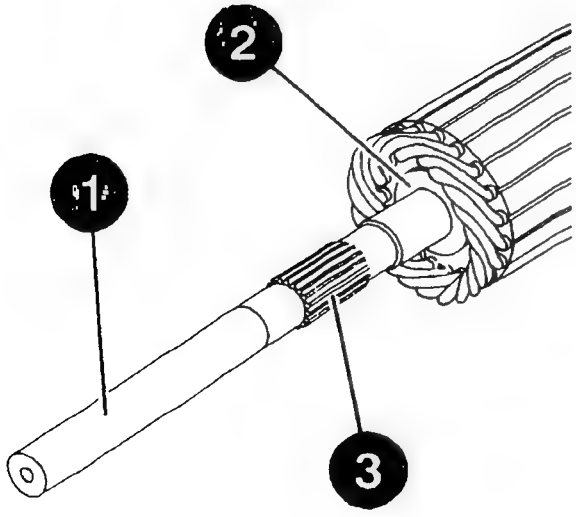


Checking armature

Examine contact surface of overrunning-clutch drive (1) and intermediate bearing (2), as well as spline shaft profile (3) for running marks and damage.
Replace armature if necessary.

Continue: II27/1 Fig.: II26/2

KMS00189



COMPONENT TESTING AND REPAIR

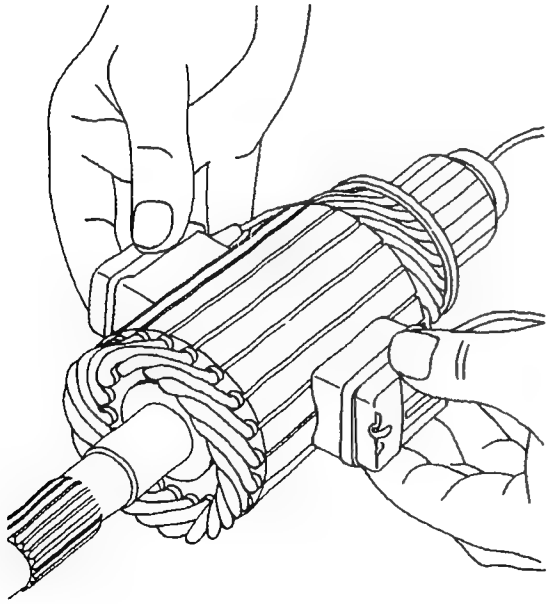
Checking armature

Check armature for interturn short circuit.
This involves using the appropriate tester and test prods.

Interturn-short-circuit tester with test prods: 0 986 619 110

Continue: II28/1 Fig.: II27/2

KMS00190



COMPONENT TESTING AND REPAIR

Checking armature

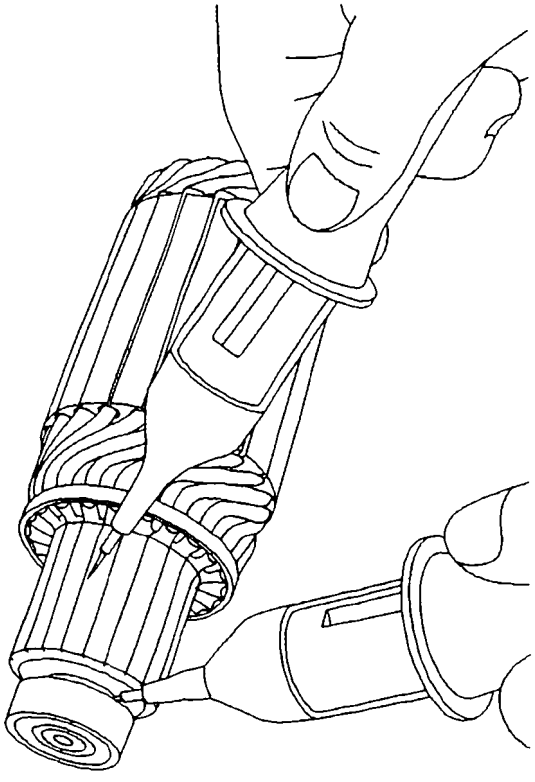
Use tester and test prods to check armature for ground short and continuity (black laminations are an indication of open circuit)

Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Ground short test voltage	
12 V starting motor:	40 V
24 V starting motor:	80 V
Continuity test voltage:	40 V

Continue: III01/1 Fig.: II28/2

KMS00191



Checking commutator

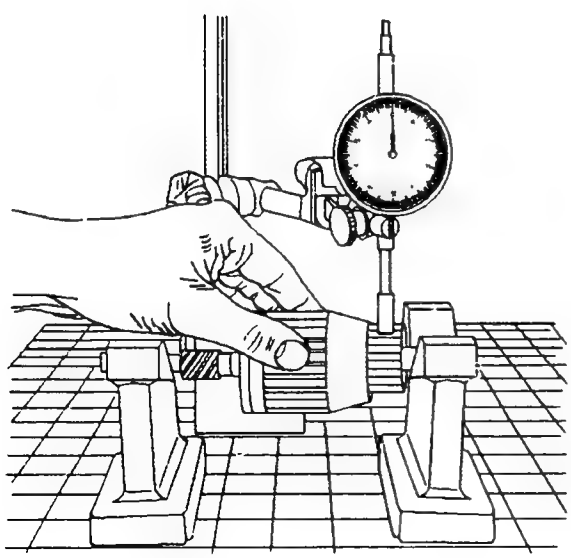
Check commutator for true running. If radial runout is not within tolerance, the commutator must be turned down.

Magnetic instrument stand:	4 851 601 124
Dial indicator:	1 687 233 011

Radial runout	
- Commutator:	0,03 mm
- Laminated core:	0,06 mm

Continue: III02/1 Fig.: III01/2

KMS00192



COMPONENT TESTING AND REPAIR

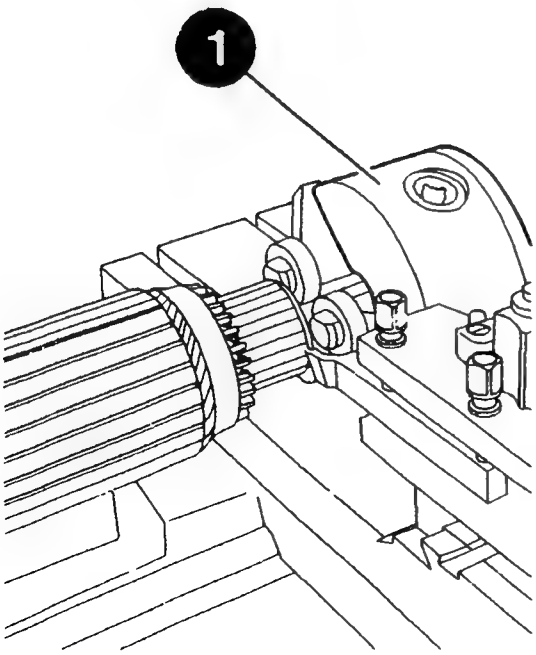
Checking commutator

Turning down involves mounting the armature in a three-jaw chuck and tailstock chuck (1).
Chip thickness must not exceed 0.03 mm.
Pay attention to minimum diameter.

Tailstock chuck with Morse taper 2:	0 986 619 156
Minimum diameter:	42,5 mm

Continue: III03/1 Fig.: III02/2

KMS00193



Checking commutator

After being turned down, the insulation of the commutator laminations must be sawn out with a suitable tool to a depth of 0.8 mm.

Continue: III03/2

After sawing, turn down commutator again and check for interturn short circuit and ground short. Pay attention to diameter.

Interturn-short-circuit tester:	0 986 619 110
Minimum diameter:	42,5 mm
Ground short test voltage	
12 V starting motor:	40 V
24 V starting motor:	80 V

Continue: III04/1

COMPONENT TESTING AND REPAIR

Checking excitation winding

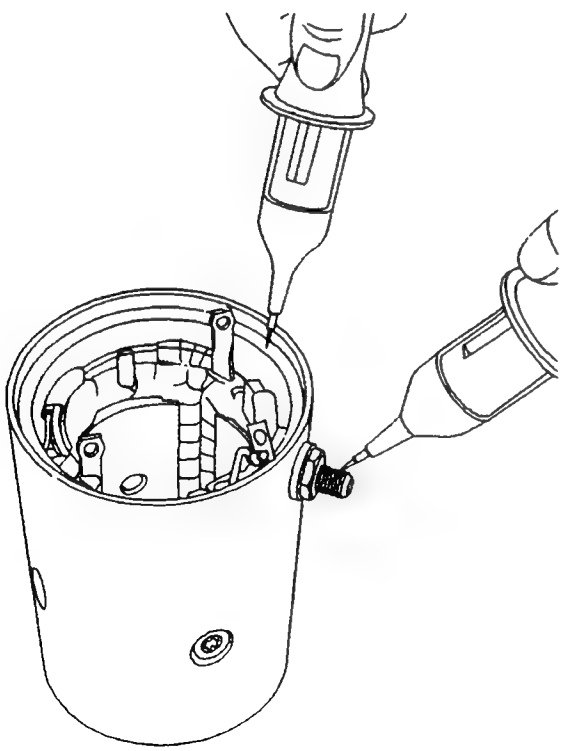
User tester and test prods to check winding for ground short.

Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Ground short test voltage	
12 V starting motor:	40 V
24 V starting motor:	80 V

Continue: III05/1 Fig.: III04/2

KMS00194



COMPONENT TESTING AND REPAIR

Checking excitation winding

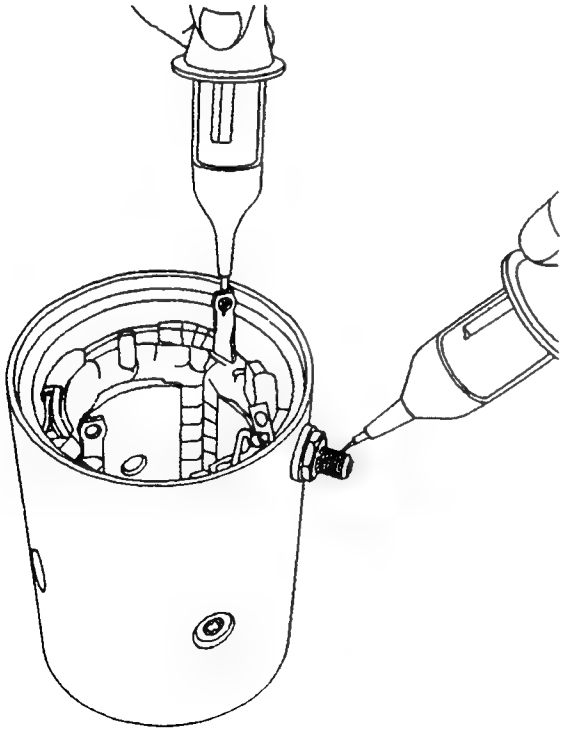
Use tester and test prods to check winding for continuity.

Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Continuity test voltage: 40 V

Continue: III06/1 Fig.: III05/2

KMS00195



COMPONENT TESTING AND REPAIR

Checking excitation winding

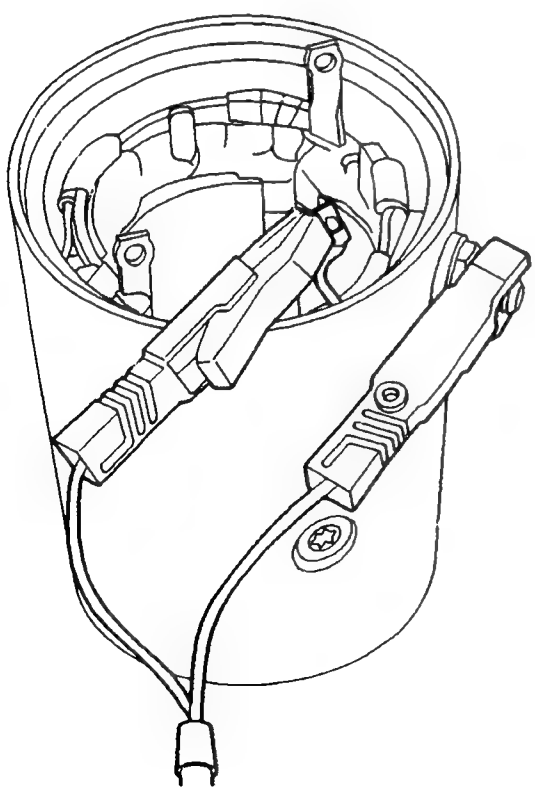
Use tester to check shunt field resistance.

Alternator tester: 0 684 201 200
(optionally Motortester)

Shunt field resistance
12 V starting motor: 0,38...0,42 Ohm
24 V starting motor: 1,60...1,76 Ohm

Continue: III07/1 Fig.: III06/2

KMS00196



COMPONENT TESTING AND REPAIR

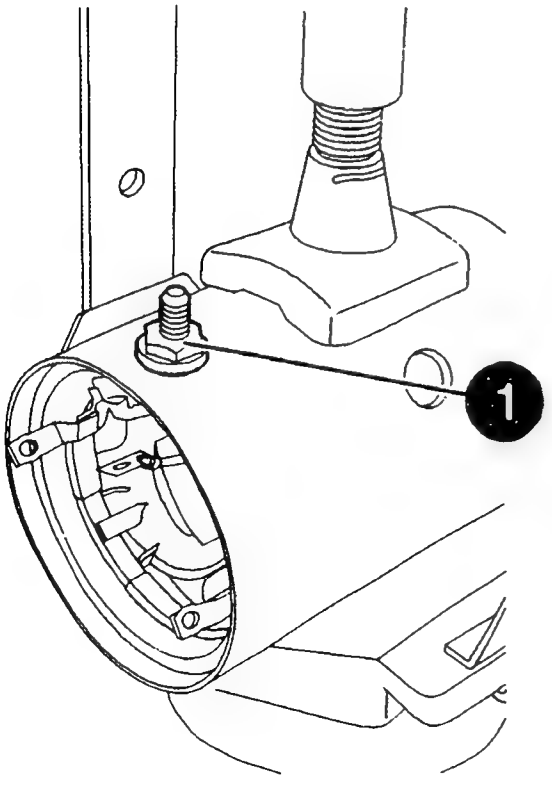
Replacing excitation winding

Replace damaged, defective, scorched or unsoldered windings.
Removing: Insert stator frame in clamping support and mark position of pole shoes. Remove securing nut for terminal screw of excitation winding (1).

Clamping support: 0 986 619 362

Continue: III08/1 Fig.: III07/2

KMS00197



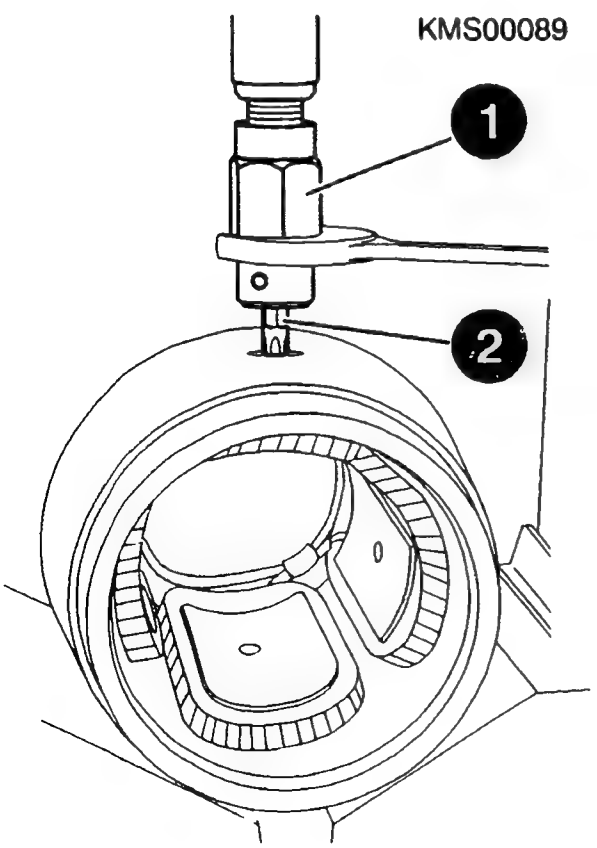
COMPONENT TESTING AND REPAIR

Replacing excitation winding

Use pole-shoe screwdriver (1) and Torx socket (2) to unfasten pole-shoe screws and remove pole shoes and winding towards drive end bearing side.

Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit socket with hexagon 5/16":	comm. avail.

Continue: III09/1 Fig.: III08/2

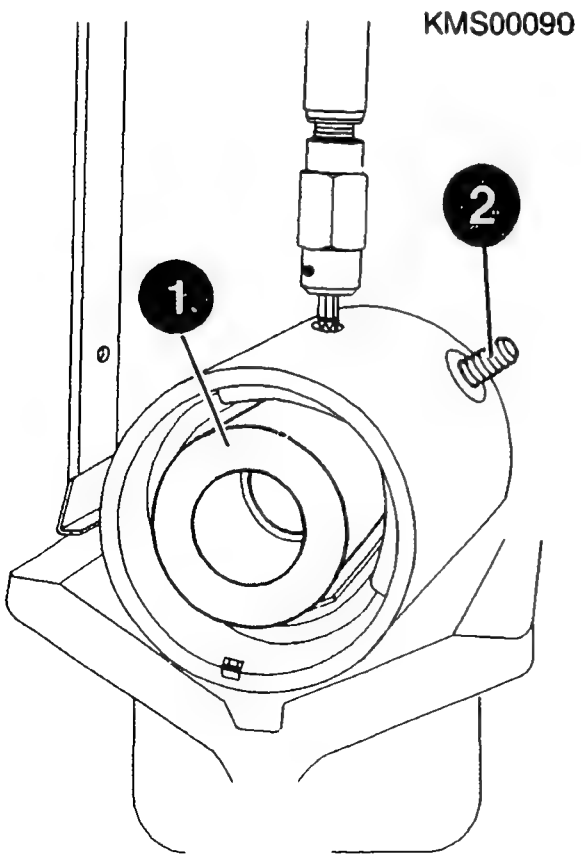


Replacing excitation winding

Installing: Warm excitation winding before fitting, insert with pole shoes in stator frame from drive end bearing side and slightly tighten pole-shoe screws. Pay attention to marks.
Press in driving-in mandrel (1).

Mandrel press:	comm. avail.
Driving-in mandrel diameter:	75,85 - 0,05 mm (user-manufacture)

Continue: III10/1 Fig.: III09/2



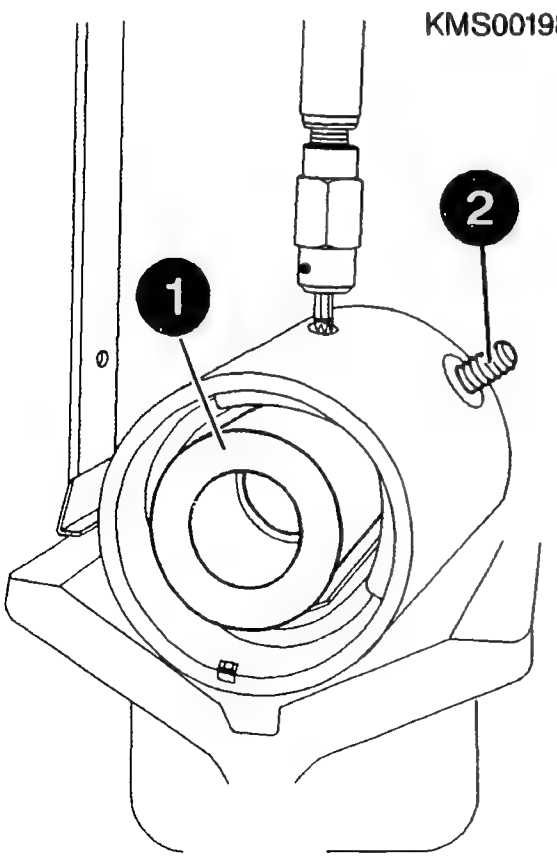
COMPONENT TESTING AND REPAIR

Replacing excitation winding

Tighten pole-shoe screws and press out driving-in mandrel (1). Fit connection of excitation winding (2).
Use torque wrench.

Mandrel press:	comm. avail.
Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit socket with hexagon 5/16":	comm. avail.
Torque wrench:	comm. avail.
Tightening torques	
Pole-shoe screws:	40...53 Nm
Terminal screw:	15...17 Nm

Continue: III11/1 Fig.: III10/2

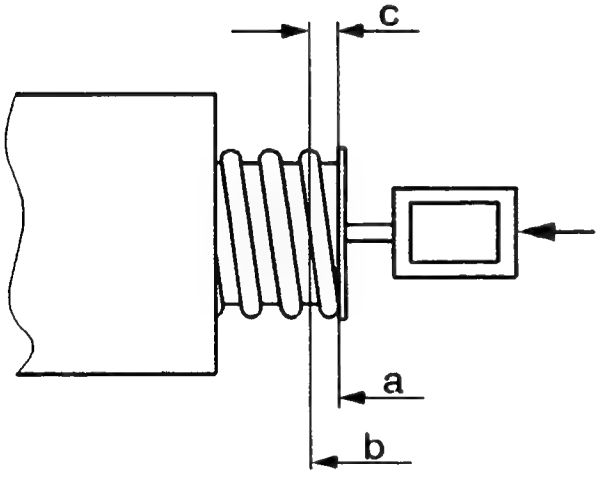


Checking solenoid switch

Examine solenoid switch for damage.
Check burn-off reserve.
Press in armature by hand until jumper makes contact (a) with terminal stud. As the armature is pressed further in as far as the stop (b), a noticeable increase in resistance can be felt. The difference between positions (a) and (b) is the burn-off reserve (c). Solenoid switch is to be replaced if there is no longer any burn-off reserve.

Continue: III12/1 Fig.: III11/2

KMS00238



COMPONENT TESTING AND REPAIR

Checking solenoid switch

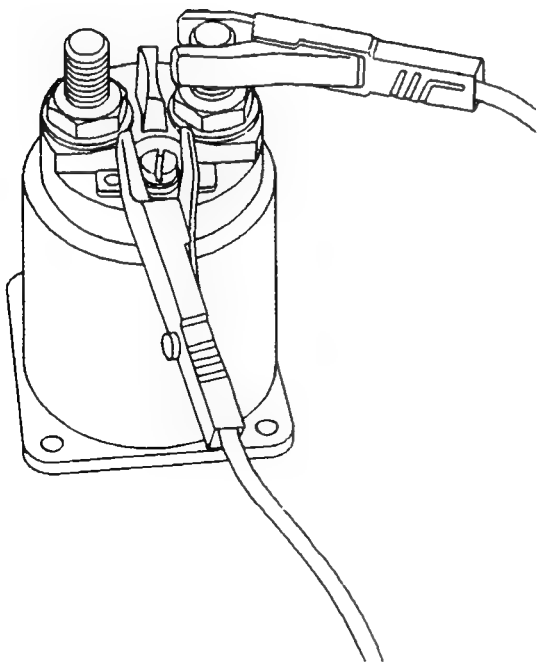
Use tester to check resistance of pull-in winding (term. 50/term. 30-f).

Alternator tester: 0 684 201 200

Resistance
12 V - solenoid switch:
0,175...0,185 Ohm
24 V - solenoid switch:
0,524...0,552 Ohm

Continue: III13/1 Fig.: III12/2

KMS00239



COMPONENT TESTING AND REPAIR

Checking solenoid switch

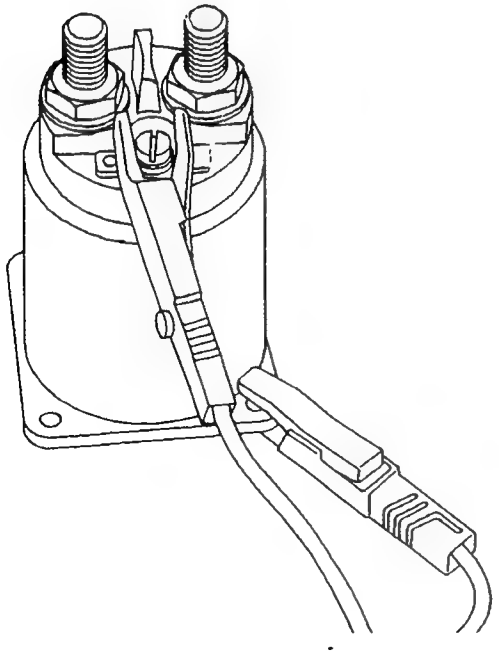
Use tester to check resistance of holding winding (term. 50/ground).

Alternator tester: 0 684 201 200

Resistance
12 V - solenoid switch:
0,421...0,443 Ohm
24 V - solenoid switch:
1,6...1,7 Ohm

Continue: III14/1 Fig.: III13/2

KMS00240



COMPONENT TESTING AND REPAIR

Checking solenoid switch

Neither the tests described nor proper functioning of the solenoid switch when testing the function of the starting motor following repair can provide reliable information on trouble-free operation of the solenoid switch over a lengthy period.
It is therefore advisable to renew the solenoid switch when repairing the starting motor.

Continue: I01/1

STARTING-MOTOR ASSEMBLY TABLE

Continue: I01/1

STARTING MOTOR ASSEMBLY

Intermediate bearing assembly

Lubricate as per lubrication schedule before and during assembly.

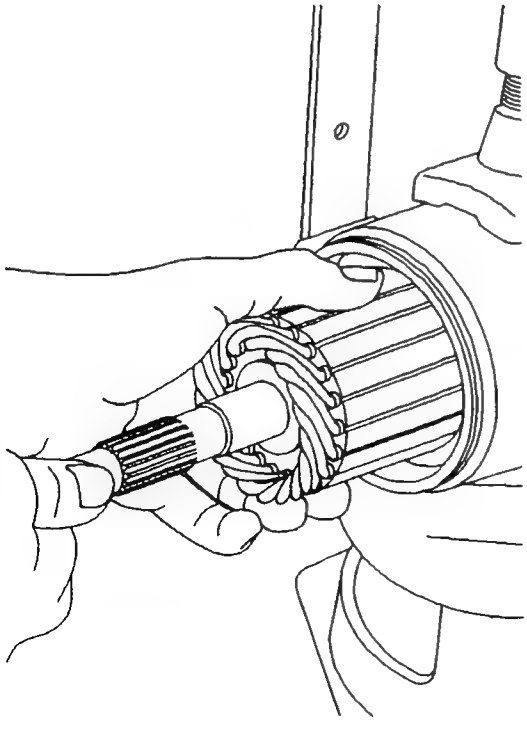
Clamp stator frame in clamping support. Insert armature in stator frame from drive end.

ATTENTION:
Take care not to damage excitation winding.

Clamping support: 0 986 619 362

Continue: III17/1 Fig.: III16/2

KMS00174



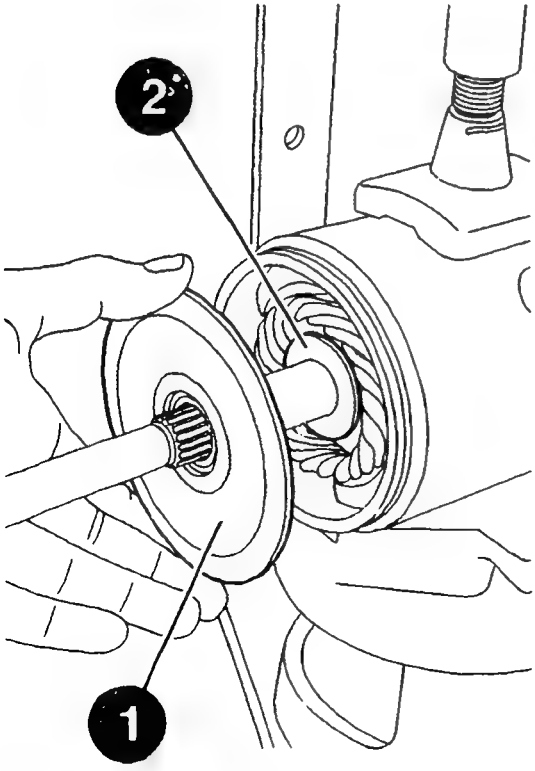
STARTING MOTOR ASSEMBLY

Intermediate bearing assembly

Slip thrust washer (2) and intermediate bearing (1) with collar facing armature winding onto armature shaft.

Continue: III18/1 Fig.: III17/2

KMS00173



STARTING MOTOR ASSEMBLY

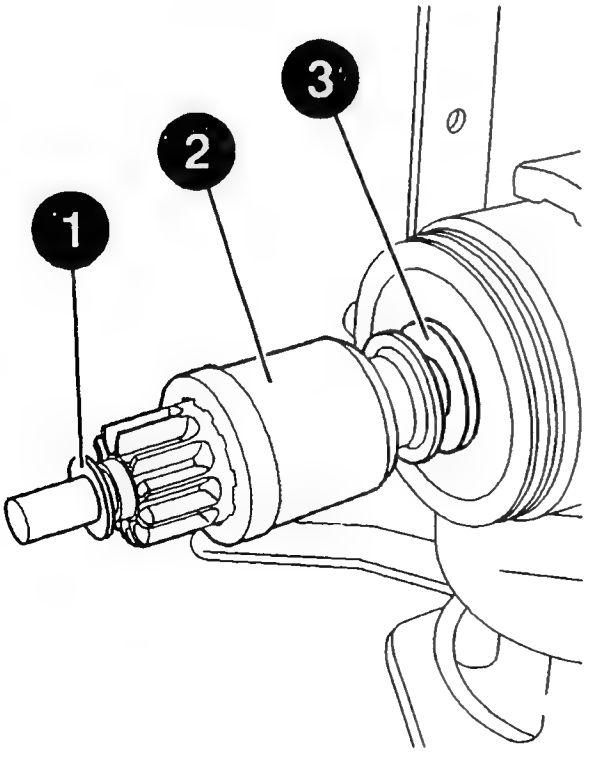
Gear unit assembly

Slip brake disk (3), overrunning-clutch drive with pinion (2) and stop disk (1) onto armature shaft.

ATTENTION:
Spline shaft profile of gear unit must be dry and free from grease to stop pasting up of armature shaft. Only grease spline shaft profile of armature shaft.

Continue: III19/1 Fig.: III18/2

KMS00172



STARTING MOTOR ASSEMBLY

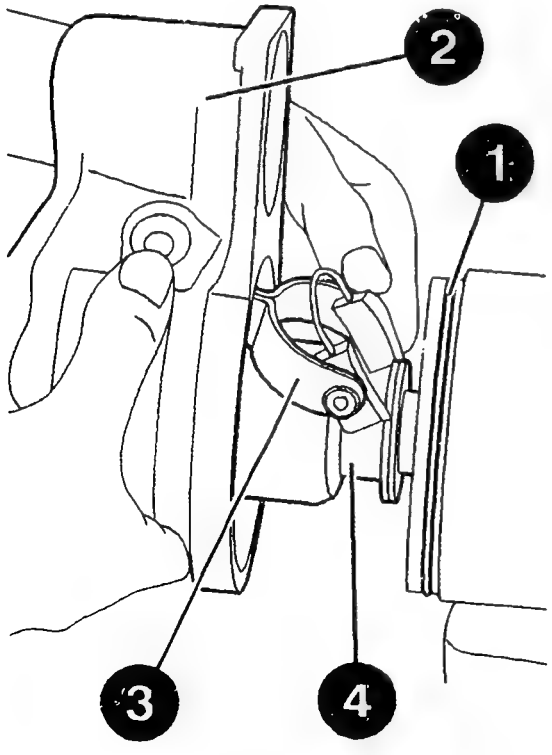
Drive end bearing assembly

Fit new O-ring (1) at drive end bearing seat of stator frame.
Slip on drive end bearing (2) together with engaging lever (3) and insert this in driver (4) at gear unit.
Ensure proper fit and pay attention to mark on drive end bearing.
Make sure armature shaft is properly seated in drive end bearing.

ATTENTION: DANGER OF INJURY
Drive end bearing is not fixed at stator frame.

Continue: III20/1 Fig.: III19/2

KMS00199



STARTING MOTOR ASSEMBLY

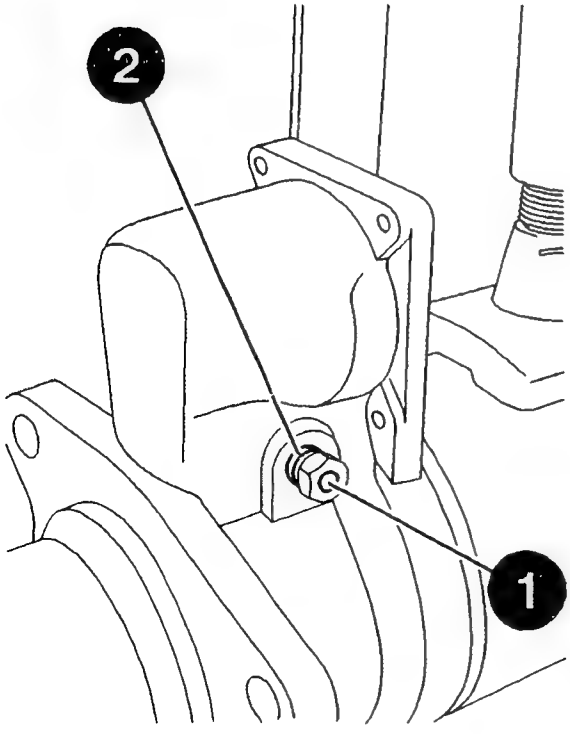
Drive end bearing assembly

If appropriate, renew bearing pin (1) of engaging lever, fit with new copper seal (2) and secure with Loctite.
Make sure engaging lever runs smoothly on bearing pin.
Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque (hexagon nut):	9...11 Nm
Loctite VS 14618 Kk:	5 965 930 512

Continue: III21/1 Fig.: III20/2

KMS00170



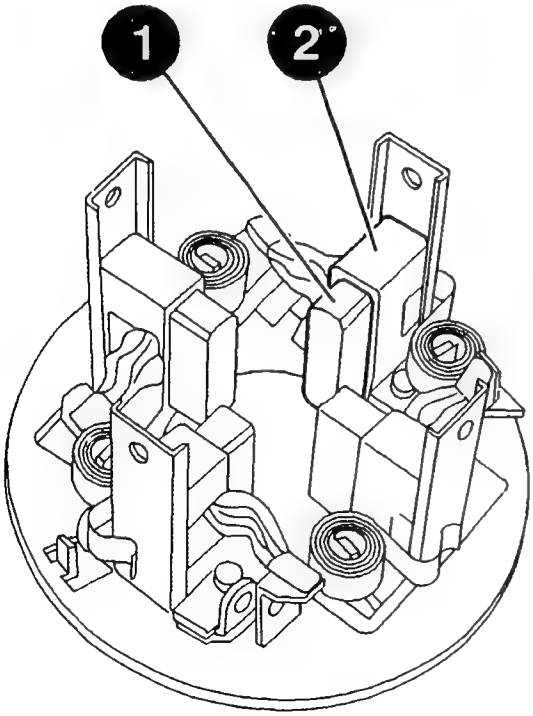
STARTING MOTOR ASSEMBLY

Carbon brush assembly

Insert new carbon brushes (1) in brush holder (2).

Continue: III22/1 Fig.: III21/2

KMS00169



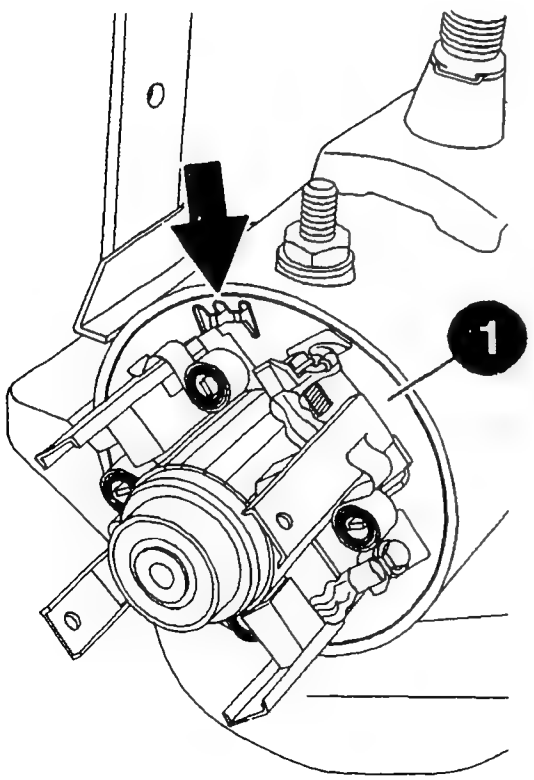
STARTING MOTOR ASSEMBLY

Brush holder plate assembly

Slip brush holder plate (1) with carbon brushes over commutator and insert in stator frame.
Lug on stator frame must engage in locking mechanism of brush holder plate (see arrow).
Ensure proper positioning.

Continue: III23/1 Fig.: III22/2

KMS00201



STARTING MOTOR ASSEMBLY

Brush holder plate assembly

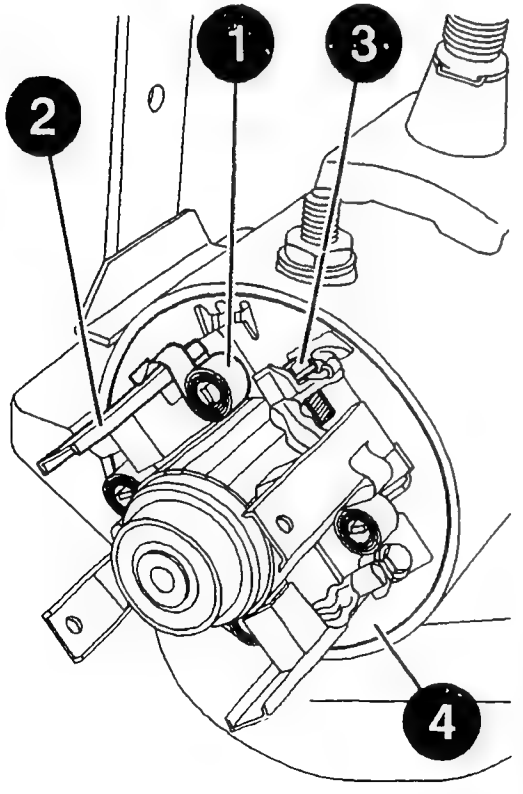
Attach connections (3) of carbon brushes and excitation winding to brush holder plate (4). Use torque wrench. Lift spiral springs (1) with appropriate tool and pull out assembly tool (2). Press stranded wires of carbon brushes outwards; make sure there is no possibility of contact with commutator.

Torque wrench: comm. avail.

Tightening torque: 3...4 Nm

Continue: III24/1 Fig.: III23/2

KMS00168



STARTING MOTOR ASSEMBLY

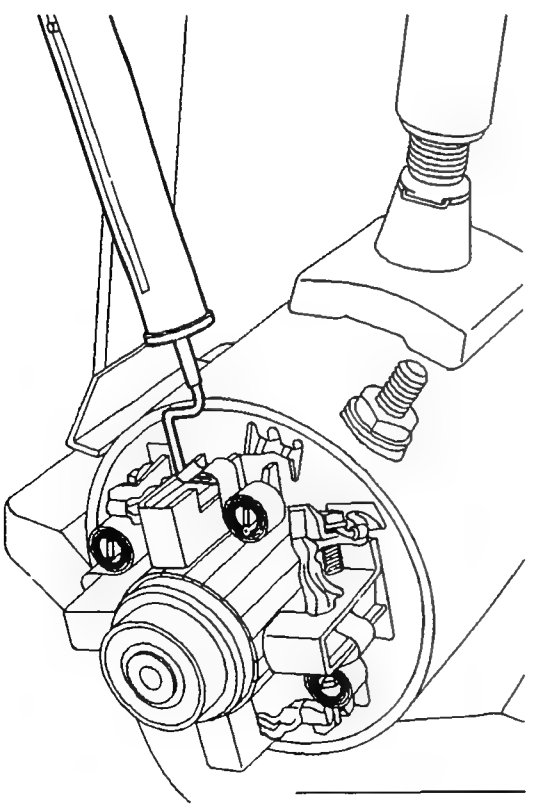
Checking brush pressure

Use spring balance to check brush pressure.

Spring balance (0...160 N):	comm. avail.
Brush pressure of new carbon brushes:	47...53 N

Continue: III25/1 Fig.: III24/2

KMS00202



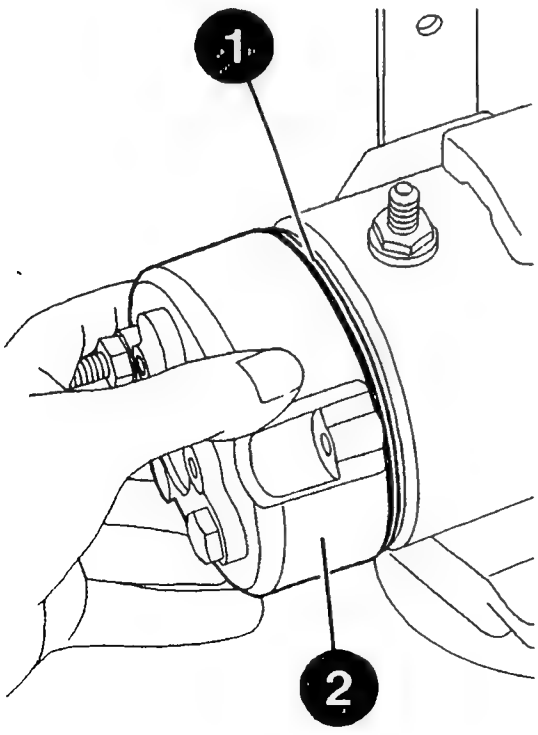
STARTING MOTOR ASSEMBLY

Commutator end shield assembly

Fit new O-ring (1) at commutator end shield (2) and insert commutator end shield in stator frame.
Pay attention to mark.

Continue: III26/1 Fig.: III25/2

KMS00183



STARTING MOTOR ASSEMBLY

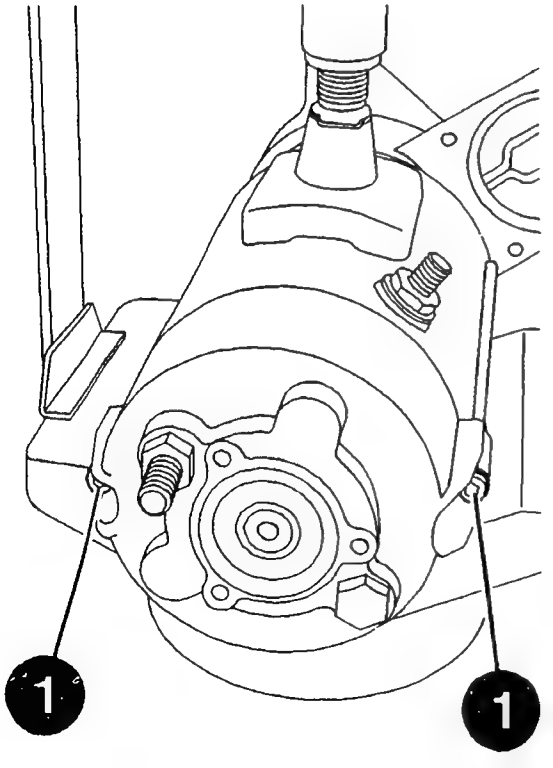
Commutator end shield assembly

Re-check proper positioning of drive end bearing and commutator end shield (marks) and secure with bolts (1). Bolts must run parallel with theoretical center axis of starting motor. Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque:	9,8...12,2 Nm

Continue: III27/1 Fig.: III26/2

KMS00203



STARTING MOTOR ASSEMBLY

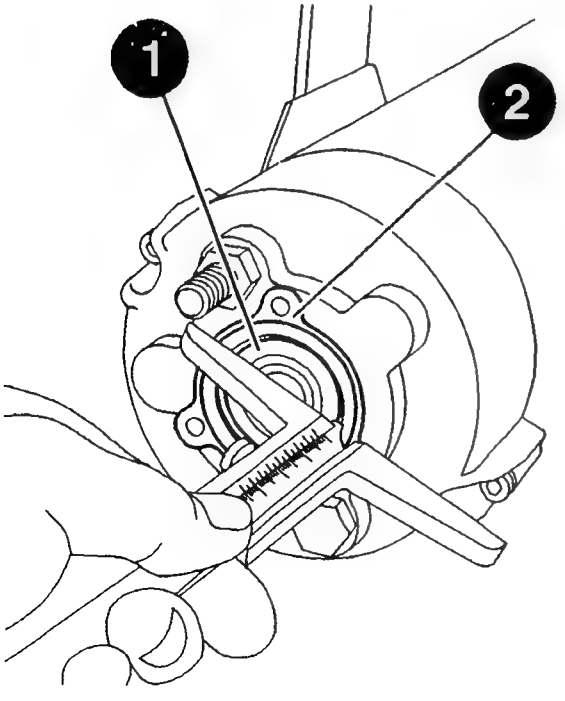
Checking and adjusting armature axial clearance

Determine indentation dimension x.
To do so, press armature with deep-groove ball bearing by hand against drive end bearing.
Use depth gauge to establish indentation dimension x between outer race of deep-groove ball bearing (1) and end face of commutator end shield (2).

Depth gauge: comm. avail.

Continue: III28/1 Fig.: III27/2

KMS00204



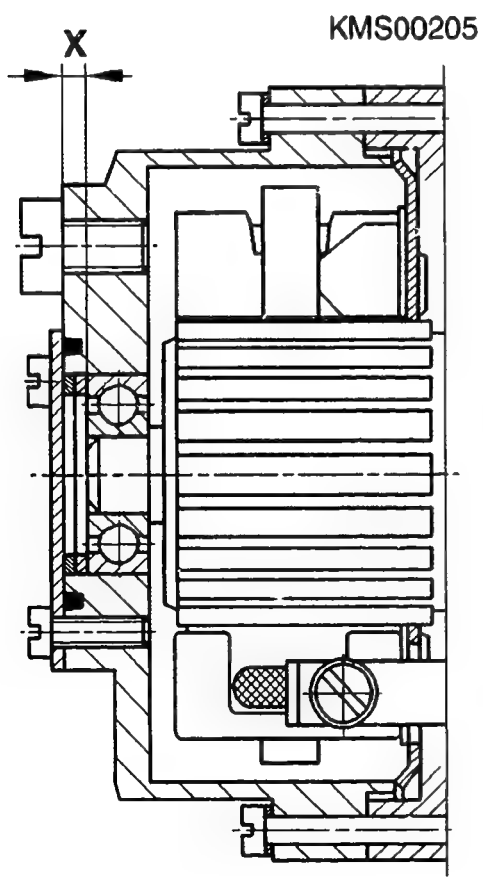
STARTING MOTOR ASSEMBLY

Checking and adjusting armature axial clearance

Provide compensation for indentation dimension x.
By fitting shims, dimension x must be reduced to the extent required to maintain a clearance of 0,1...0,3 mm between outer race of deep-groove ball bearing and end face of commutator end shield.
Three different shims are available for this purpose with thicknesses of 1.0 mm, 1.2 mm and 1.5 mm.

Armature axial clearance: 0,1...0,3 mm

~~Continue: IV01/1 Fig.: III28/2~~



STARTING MOTOR ASSEMBLY

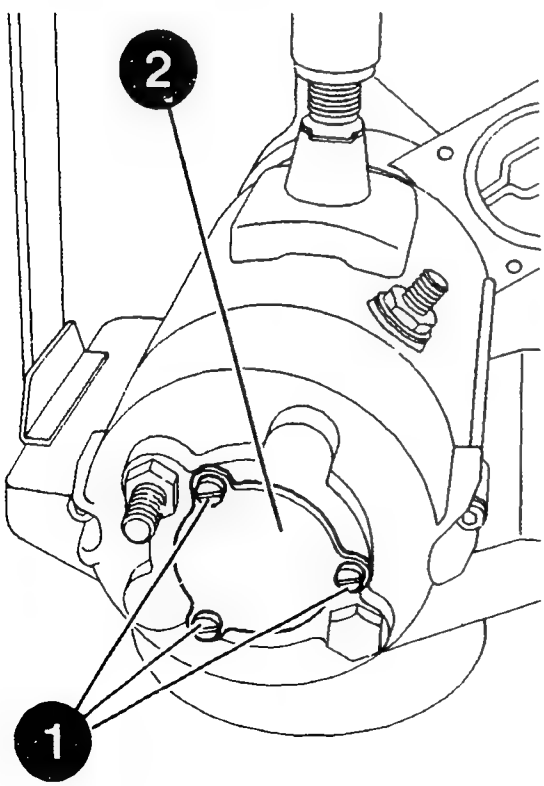
Bearing end plate assembly

Insert new O-ring in annular groove of commutator end shield and secure bearing end plate (2) with the three bolts (1).
Use torque wrench.
Make sure O-ring and shims are properly positioned.
Check freedom of movement of armature.

Torque wrench:	comm. avail.
Tightening torque:	4...5 Nm

Continue: IV02/1 Fig.: IV01/2

KMS00166



STARTING MOTOR ASSEMBLY

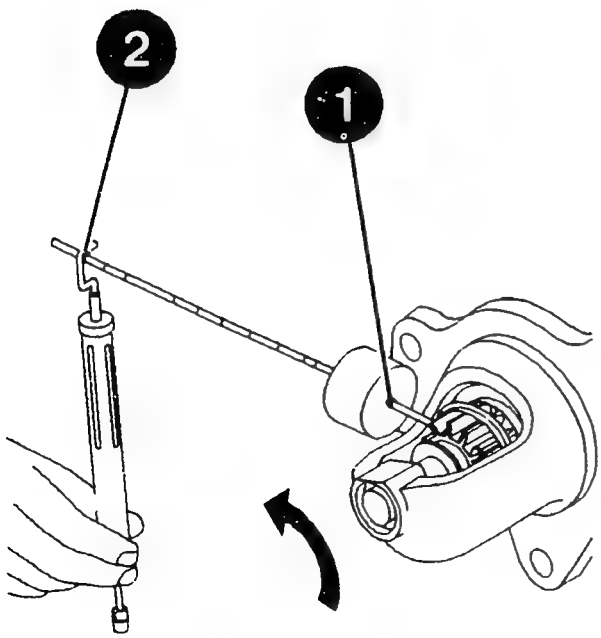
Checking armature braking torque

Apply torquemeter at pinion such that it is loaded in direction of operation (see arrow).
Move torquemeter to horizontal position.
Shift weight to second mark "2.0" (1). Suspend spring balance at last mark "8" (2).

Torquemeter:	0 986 617 206
Spring balance:	0 986 619 181

Continue: IV03/1 Fig.: IV02/2

KMS00242



STARTING MOTOR ASSEMBLY

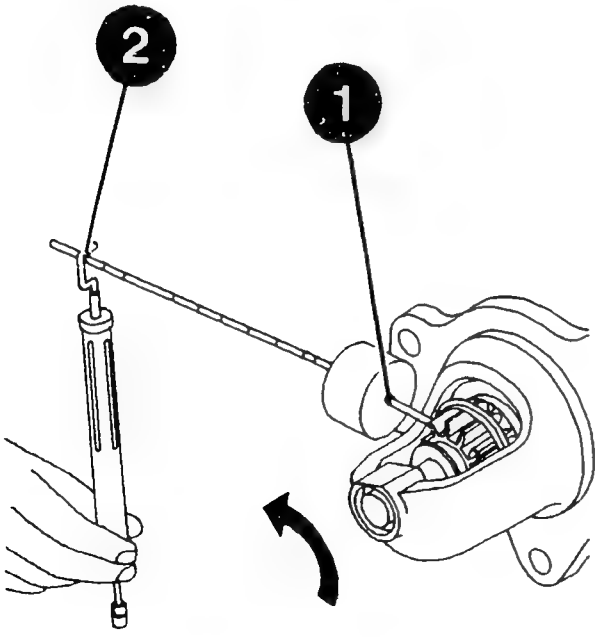
Checking armature braking torque

Pull on spring balance until pinion and armature start to turn.
Take scale reading from spring balance. This must be between 0,21...0,35 kg, corresponding to a tensile force of 2,0...3,4 N.
The armature braking torque is then within the required range.
If this is not the case, check both the components and their assembly.

Armature braking torque: 0,8...1,2 Nm

Continue: IV04/1 Fig.: IV03/2

KMS00242



STARTING MOTOR ASSEMBLY

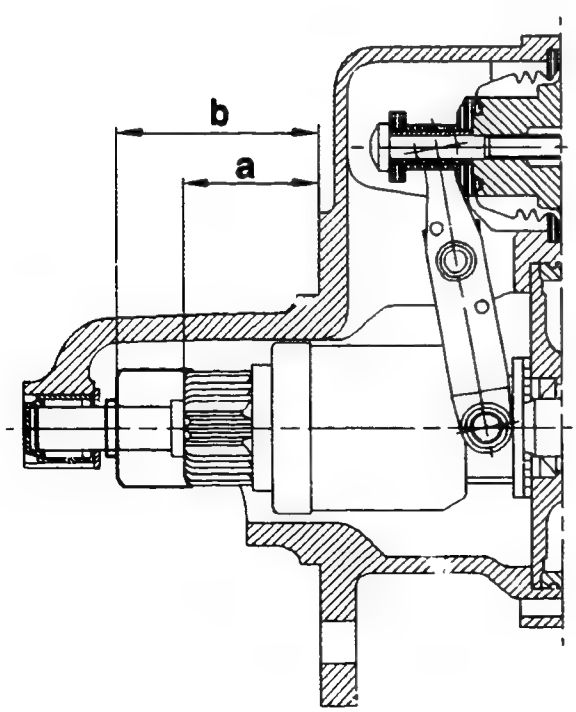
Checking pinion rest position

Dimension a for pinion rest position and total pinion travel b must be within stated range.
If not, check both the components and their assembly.

Pinion rest position a: 47 ...49 mm
Total pinion travel b: 68,2...70,8 mm

Continue: IV05/1 Fig.: IV04/2

KMS00206

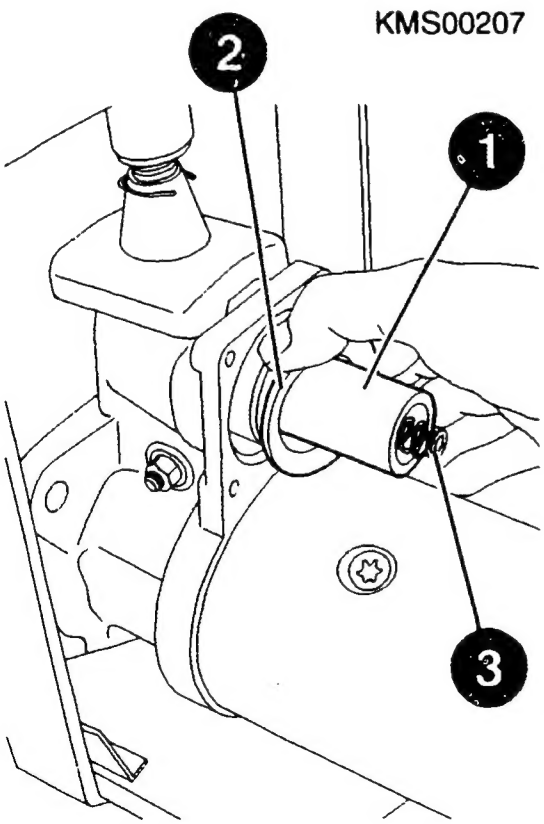


STARTING MOTOR ASSEMBLY

Solenoid switch assembly

Re-clamp starting motor.
Press pinion against stop disk, grasp switch armature (1) at rubber bellows (2) and place in position at engaging lever.
Pay attention to reset spring (3).

Continue: IV06/1 Fig.: IV05/2



STARTING MOTOR ASSEMBLY

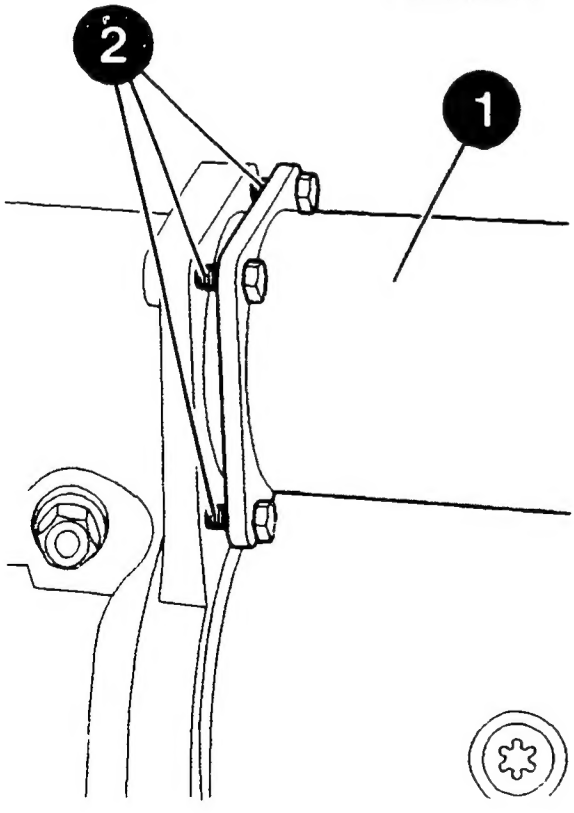
Solenoid switch assembly

Slip solenoid switch (1) onto switch armature and screw on at drive end bearing. Pay attention to mark.
Always use 4 new securing bolts (2) of strength class 10.9.
Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque:	7,6...8,4 Nm

Continue: IV07/1 Fig.: IV06/2

KMS00208



STARTING MOTOR ASSEMBLY

Solenoid switch assembly

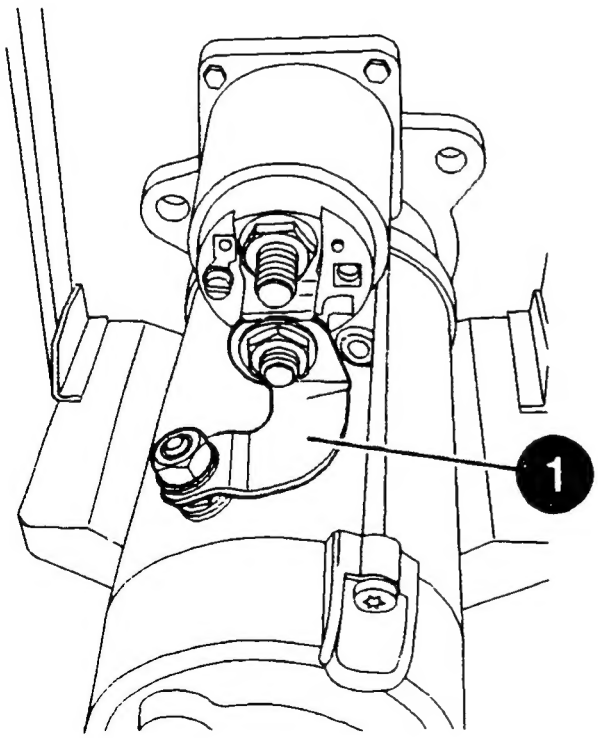
Attach busbar (1) to solenoid switch and terminal stud of excitation winding.
ATTENTION: First tighten the two securing nuts by hand.
Use torque wrench.

Torque wrench:	comm. avail.

Tightening torque	
At terminal screw of excitation winding:	15...17 Nm
At solenoid switch:	16...20 Nm

Continue: I01/1 Fig.: IV07/2

KMS00163



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Continue: IV08/2

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Continue: I01/1